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State Library.

THE MAN OF BUSINESS,

—AND—

RAILROAD CALCULATOR.

BY REV. BRANTLEY YORK, D. D.

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Raleigh

THE MAN OF BUSINESS

—AND—

RAILROAD CALCULATOR,

CONTAINING

SUCH PARTS OF ARITHMETIC AS HAVE A SPECIAL APPLICATION IN BUSINESS TRANSACTIONS,

—AND ALSO—

ABRIDGED FORMS OF OPERATION; TOGETHER WITH SUCH PROOFS AS ARE REQUISITE TO TEST THE ACCURACY OF EACH OPERATION.

—o—

BY REV. BRANTLEY YORK, D. D.

—o—

TO WHICH ARE APPENDED A FEW OF THE

PLAINER LEGAL FORMS

NECESSARY IN ORDINARY BUSINESS,

PREPARED BY

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PREFACE.

An ardent desire to be useful, has prompted the author to prepare this work for publication. If this object be attained, he will have reached the height of his ambition.

Long experience in teaching, and attentive observation, have convinced him that this or some similar work is needed; it is a fact patent to business men generally that not a few of those who go into any of the business departments of the country, notwithstanding they may have gone through an academical course of instruction, have to learn how to transact business efficiently, after they engage in it. How far this work may go in supplying the wants of any community in this respect, is not for the Author to decide; but it is left for a discerning and appreciating public to determine.

Dispatch and accuracy are prime qualities in all business transactions: time is not only money; but, in many respects, it is more. In the MAN OF BUSINESS AND RAIL ROAD CALCULATOR, the means are ample for acquiring both these qualities; the former may be acquired by attentively studying the abridged forms of operation; the latter by applying the tests of accuracy as exhibited in the proofs of the various operations.

This work is not intended to supercede any Arithmetic in use; but to afford the means in a condensed form for acquiring a business education; it, however, contains a suffi-

cient number of arithmetical *principles* and *rules* for the solution of all the questions or problems which it contains.

Though care has been taken to avoid error both in theory and practice, yet doubtless some will be found, and the Author will be obliged to any one discovering any errors in it, to promptly point them out to *him*.

This book is not intended for the use of private learners only; but also for schools—in short, for all who may see proper to use it.

In the preparation of this work, various Authors have been consulted; but the Author deems it unnecessary to specify any.

Had the Author possessed the advantage of vision, some of the forms, perhaps, would have been arranged to better advantage; but the book, such as it is, is now offered to a discriminating and indulgent public.

THE AUTHOR.

RUFFIN BADGER, *March 5th*, 1873.

PRELIMINARIES.

Definitions, Principles, and Rules.

ARTICLE I. 1. *Quantity* is anything which is susceptible of measurement.

2. *Arithmetic* is the science of numbers, and the art of computation.

3. A *unit* is a single thing denoting a whole, and is either abstract or concrete.

4. An *abstract* unit does not express the kind of unit; as, one, two, &c.

5. A *concrete* unit expresses the kind of unit; as, one apple, one pound of tea, etc.

NUMBERS.

II. 1. A *number* is a unit or a collection of units; as, one, two, six, etc.

2. An *abstract* number expresses number simply, irrespective of the kind of unit.

3. A *concrete* or *denominate* number expresses the kind of unit designated; as, two pounds, five yards, etc.

4. A *simple* number expresses one kind, whether abstract or concrete.

METHODS OF EXPRESSING NUMBERS.

III. 1. There are three methods of expressing numbers, viz:

1. By *written* or *printed words;* as, four, nine, etc.

2. By *capital letters* called the *Roman Method.* For this purpose, seven capital letters are used, viz: I, one, V, five, X, ten, L, fifty, C, one hundred, D, five hundred, M, one thousand.

3. By figures called the *Arabic Method;* as, 1, 2, 3, 4, etc.

IV. There are four principles involved in expressing numbers by the Roman Method.

1. A letter of less value, prefixed to one of greater value, subtracts its value from the greater; as, IX=nine.

2. A letter of less value, annexed to one of greater value, adds its value to the greater; as, XI=eleven.

3. A letter repeated, repeats its value; as, C C,=two hundred.

4. A dash placed over a letter, multiplies it by one thousand; as $\overline{V}$=five thousand.

NOTE.—This method is now principally used to number volumes, chapters of books, primary rules, to mark the hours on the faces of clocks and watches, dates engraven on tomb-stones, and generally to express the number of dollars on bank bills.

EXERCISES.

V. 1. Express by the Roman Notation the following numbers, 4, 15, 19, 30, 34, 40, 49, 50, 60, 72, 300, 95, 500, 800, 1000, 1200, 150, 600, 1873.

2. Express the following Roman Notation in figures, XII, XIII, XVI, XX, XXVII, XL, LXV, LXXIII, CCC, XC, D, DCCCC, MD, MDCC, M, MDCCC, LXXIII.

ARABIC METHOD.

VI. 1. There are ten characters used in the Arabic Meth-

od, called figures, viz: 1, 2, 3, 4, 5, 6, 7, 8, 9, 0. Nine of these are called digits or significant figures, the other is called naught or cipher.

2. Figures have two values, a positive and a local value. A figure has a positive value, when it stands alone or occupies the unit's place; thus 5 expresses simply five units; but, if another figure be written on the right hand of it, its value becomes local; thus 55; its value now is fifty units or five tens, tens being the scale expressing the law of increase and decrease.

3. All the operations in Arithmetic are performed by variously combining these figures.

FUNDAMENTAL OR GROUND RULES.

VII. 1. Notation and Numeration, Addition, Subtraction, Multiplication and Division are called fundamental or ground rules; because some of them underlie or are the foundation of all other operations.

SIGNS BY WHICH THE OPERATIONS ARE INDICATED.

VIII. 1. Two short parallel lines (=) *equal to*, are placed between two numbers or quantities of equal value; as, 2+5=7.

2. An upright cross (+) called *plus*, is the sign of Addition; as, 2+4=6.

3. A short horizontal line (—) called *minus*, is the sign of Subtraction. The minuend is written on the *left* hand, and the subtrahend on the *right;* as 8 min.—2 sub.=6.

4. An oblike cross ($\times$) called *times* or *into*, is the sign of Multiplication; as, $5\times4=20$.

5. The sign of division is a horizontal line drawn between two dots ($\div$) called "*by.*" The Dividend should be written on the left, and the Divisor on the right hand. Ex. $24\div6=4$. This operation is sometimes indicated by a single line with the Dividend written above, and the Divisor below; thus, $\frac{24}{6}=4$, or by a curve and horizontal line united; thus $6\,)\frac{24}{4}$.

6. The sign of aggregation, a parenthesis, ( ), including several numbers or a vinculum, ——, drawn over them, indicates that the value of the expression, is to be used as a single number. Thus $(12+3)\times5$ indicates that the sum of 12 *and* 3, is to be multiplied by 5; and $10+\overline{(8-2)}\div2$, indicates that the difference between 8 and 2, divided by 2, is to be added to 10.

7. The sign of a conclusion, is three dots placed thus ($\therefore$) called *therefore.*

AXIOMS.

IX. The operations of Arithmetic as a branch of Mathematics, are based upon certain axioms. An axiom is a self-evident truth of which there are several kinds as follows:

1. If the same quantity or equal quantities, be *added* to equal quantities, the *sums* will be equal.

2. If the same quantity or equal quantities be *subtracted* from equal quantities, the *remainders* will be equal.

3. If the same quantity or equal quantities be *added* to unequal quantities, the *sums* will be unequal.

4. If the same quantity or equal quantities be *subtracted* from unequal quantities, the *remainders* will be unequal.

5. If equal quantities be *multiplied* by the same quantity or equal quantities, the *products* will be equal.

6. If equal quantities be *divided* by the same quantity or equal quantities, the *quotients* will be equal.

7. If the same quantity be both *added to* and *subtracted from* another, the *value* of the latter will not be changed.

8. If a quantity be both *multiplied* and *divided* by the same quantity, its *value* will not be changed.

9. If two quantities be equally increased or diminished, the *difference* will not be changed.

10. Quantities which are equal to the *same* quantity, are equal to each other.

11. Quantities which are like parts of equal quantities, are equal to each other.

12. The *whole* of a quantity, is greater than *any* of *its parts*.

GROUND RULES—METHODS OF PROOF.

X. 1. *Notation* is the expression of numbers, whether by words, letters or figures.

2. *Numeration* is reading figures correctly in their proper order, of which there are two methods. The first is called the French Method, in which the figures are grouped together by threes, called periods. Thus (Mill. Thous. Units.) 555,555,555. The second is called the English Method, and each group contains six figures, except the left hand period which may contain less. The former is decidedly preferable.

XI. *Addition* is the operation by which several numbers are collected into one aggregate amount or whole.

Ex., 325
——Operation.
413
136
72
——
946 Amount.
——
621 Second Amount.
325 Top line, remaining Part.
——
946 Proof = First Amount.

Now since all the parts are equal to the whole, if we separate any one part; as the top line for instance, adding the other parts, the second amount will not be equal to the first (axiom 12); again, if we add the second amount to the part separated, it will be equal to the first amount which is the proof of the operation, (axiom 13). This process may be facilitated by performing the operation in the opposite direction, though less scientific.

SUBTRACTION.

XII. *Subtraction* is an operation by which the difference of two given numbers, is determined. Ex. $\overset{\text{min.}}{24}-\overset{\text{sub.}}{8}=\overset{\text{rem.}}{16}$. Proof, $8+16=24$. Second Method, or $24-16=8$. Now since 24 has been diminished by 8, it follows, if 8 be added to the difference, (16), the amount will be 24, equal to the minuend (see axiom 1). Hence the rule for proving subtraction.

Add the remainder and subtrahend, and their sum will be equal to the minuend, or subtract the difference from the minuend, and the remainder will be equal to the subtrahend. See the above example.

MULTIPLICATION.

XIII. Multiplication is an operation by which one given factor is repeated as many times as these units in another given factor.

REMARK 1. The larger factor or number is generally called the *multiplicand*, the less is generally called the *multiplier*, and the result of the operation is called the *product*.

REMARK 2. If the multiplier is a unit, the product will be equal to the multiplicand, if the multiplier is more than a unit, the product will be as many times greater than the multiplicand, as there are units in the multiplier; but, if the multiplier is a fraction or less than a unit, the product will be less than the multiplicand.

Note.—The different positions of the factors will make no difference in the result. Hence convenience only may be consulted.

Proof.—Now since the product expresses the result of multiplying two factors together, it follows that, if we divide the product by either factor, the quotient will be the other. (See axiom 8). Hence we have the following rule for proving multiplication.

Divide the product by the multiplier, and the quotient will be equal to the multiplicand, or divide the product by the multiplicand, and the quotient will be equal to the multiplier; as exhibited by the following example. What will 12 yards of calico come to at 12½ cents a yard? Operation, $12 \times 12\frac{1}{2} = 1.50$. Proof, $1.50 \div 12 = 12\frac{1}{2}$.

Note.—There are other methods of proving multiplication; but we deem the above sufficient.

DIVISION.

XIV. *Division* is the operation of finding how many times one number is contained in another.

Remark. The container, or number to be divided, is called the *dividend.* The contained or number expressing the number of parts into which the dividend is to be divided, is called the *divisor.* The number expressing the number of times which the dividend contains the divisor, is called the *quotient*, and that which is sometimes left undivided, is called the *remainder.*

Rem. 2. If the divisor is a unit, the quotient will be equal to the dividend, if the divisor contains more than a unit, the quotient will be less than the dividend by as many times as there are units in the divisor; but, if the divisor is a fraction or less than a unit, the quotient will be greater than the dividend.

Rem. 3. When the divisor is greater than the dividend, a part only of it can be contained in the dividend; therefore, the operation can only be indicated by making the dividend a numerator of a common fraction, and the divisor, the denominator. Thus let it be required to divide 3 by 5. Operation, $\frac{3}{5}$.

Note.—The dividend is a product, of which the divisor is one of the factors, and the quotient the other. Hence, when either factor is given, the other may be found.

Proof of Division.—Now since the quotient expresses the number of times which the dividend contains the divisor, it follows that, if we multiply the quotient by the divisor, adding in the remander, if any, the product will be equal to the dividend, (see axiom 8), as exhibited in the following example. Divide 24 by 6. Operation, $24 \div 6 = 4$. Proof, $6 \times 4 = 24$ or $24 \div 4 = 6$, Second Method. Hence the following rule for division.

Multiply the quotient by the divisor, adding in the remainder, if any, and the product will be equal to the dividend, or divide the dividend by the quotient, and the result will be the divisor. (See note).

PRACTICAL RULES DEDUCED FROM THE FOREGOING PRINCIPALS.

XV. 1. When the price of any concrete unit, is given, and the price or amount of given number required—*Multiply the price by the given number, and the product will be the required result.*

Ex. What will 24 yards of calico come to, at 14 cents a yard. Operation, $24\times14=3.36$.

2. When the cost of a number of things is given, and the price of a single concrete unit required—*Divide the cost by the given number, and the quotient will be the price of a single concrete unit.*

Ex. Paid 4.80 for 40 yards of cloth—required the price of one yard? Operation, $4.80\div40=12$, the cost of a single concrete unit.

3. When it is desired to divide a concrete number into any number of equal parts—*Divide the given number by a number whose concrete units are equal to the number of parts desired, and the quotient will be one of the equal parts;* thus, let it be required to divide 425 acres equally among five persons. Operation, $425\div5=85$, one of the equal parts.

DENOMINATE NUMBERS.

XVI. 1. A denominate number is a collection of concrete units of different denominations; as 3 ft., 4 in., 5s., 6d, &c.

A *scale* expresses the law of relation between units of different numbers of different kinds.

3. The scale of most denominate numbers is *variable;* the scale of the United States currency is uniform, whose radix is *ten;* and the scale of duodecimals is also uniform, whose radix is *twelve.*

REDUCTION OF DENOMINATE NUMBERS.

XVII. 1. Reduction of denominate numbers consists in reducing a denominate number from one denomination to another, without changing its value.

2. There are two kinds of reduction, viz: Descending and Ascending; the *former* is affected by multiplication, the *latter* by division.

3. The scale, in every case, must be the rule of operation.

Note.—The principal tables of denominate numbers are here inserted, as a matter of reference, accompanied by such explanatory notes as are deemed important.

ENGLISH MONEY.

XVIII. English or Sterling money is the currency of England.

TABLE.

4 Farthings	make	1 Penny,	*d.*
12 Pence	make	1 Shilling,	*s.*
20 Shillings	make	1 Pound,	£.

Note 1.—The English coins consist of the Five-Sovereign piece, the double Sovereign, the Sovereign, and half Sovereign, made of Gold; the crown, the half crown, florin, the shilling, the six-pence, the four-pence, the three-pence, the two-pence, the one-and-half-pence, and the

penny, made of Silver; the penny, the half-penny, the farthing, and the half-farthing, made of Copper.

Note 2.—Farthings are now generally expressed by the fractional parts of pence; 1 farth.=¼d, &c.

Note 3.—The value of the English Guinea, is 21 shillings; but the Guinea, five Guinea, half Guinea, quarter Guinea, and seven-shilling piece are no longer coined.

Note.—The value of the Sovereign is equal to 1 pound Sterling=$4.84 United States currency, and the value of the Florin is equal to $\frac{1}{10}$ of 1 £.

AVOIRDUPOIS OR COMMERCIAL WEIGHT.

XIX. This weight is used for weighing almost any thing except Gold and Silver and precious stones.

DENOMINATIONS.

Ton, Hundred-weight, Quarter, Pound, Ounce, and Dram.

TABLE.

16 Drams (dr.)	make	1 Ounce,	Oz.
16 Ounces	make	1 Pound,	℔.
25 Pounds	make	1 Quarter,	Qr.
4 Quarters	make	1 Hundred-weight,	Cwt.
20 Hundred-weight	make	1 Ton,	T.

Note.—The laws of most States and common practice have adopted the decimal 100; but formerly it was 112 the quarter being 28, which is still the standard of the *United States Government* in collecting duties at the custom-houses.

TROY OR MINT WEIGHT.

XX. This weight is used to weigh *Gold*, *Silver*, *Jewels*, and *Liquors*.

DENOMINATIONS.

Pound, *Ounce*, *Pennyweight*, *and Grain*.

TABLE.

24 Grains (gr)	make	1 Pennyweight,	pwt.
20 Pennyweight	make	1 Ounce,	oz.
12 Ounces	make	1 Pound,	℔.

Note 1.—Diamonds and other precious stones are weighed by what is called:

Diamond weight, of which 16 parts make 1 gr.; 4 gr., 1 *carrot*. 1 gr. Diamond weight is=to 4 gr., Troy, and 1 carrot=$3\frac{1}{5}$ gr. Troy. In weighing pearls, the pennyweight is divided into 30 gr., instead of 24, so that 1 pearl gr. is=$_5$ gr. Troy, and 1 carrot=$3\frac{1}{5}$ gr. Troy.

Note 2.—The *assay carrot is a term used to express the proportional part of a weight, as expressing the fineness of Gold; each carrot=$\frac{1}{24}$ part of the entire mass used. Thus, pure gold is termed 24 carrot gold, and not pure is termed 18 carrot gold, 20 carrot gold, etc., ie., 18 carrot gold has 18 parts of gold and 6 parts alloy, and may be expressed fractionally thus, $\frac{18}{24}$, $\frac{20}{24}$, $\frac{22}{24}$, etc. Each assay carrot is subdivided into 4 assay grains, and each assay grain, in 4 assay quarters.

* Care should be taken not to compound the carrot of *weight* with *assay* carrot.

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APOTHECARIES WEIGHT.

XX. This weight is used in weighing medical prescriptions.

DENOMINATIONS.

Pound, Ounce, Dram, Scruple, and Grain.

TABLE.

20 Grains (gr)	make	1 Scruple,	Sc.
3 Scruples	make	1 Dram,	dr.
8 Drams	make	1 Ounce,	oz.
12 Ounces	make	1 Pound,	lb.

Note.—Medicines are usually bought and sold by Avoirdupois weight.

Note 2.—In estimating the weight of fluids. 45 drops, or a common teaspoonful make 1 fluid dram, 12 common tablespoonfuls, about one fluid ounce; a wine-glassful, about 1½ fluid ounces, and a common teacupful about 4 fluid ounces.

LINEAR OR LONG MEASURE.

XXI. Linear measure has but one dimension, and is used in measuring distances in every direction.

TABLE.

12 Inches (in)	make	1 Foot,	ft.
3 Feet	make	1 Yard,	yd.
5½ Yards or 16½ Feet	make	1 Rod or Poll,	rd.
40 Rods	make	1 Furlong,	fur.
8 Furlongs or 320 Rods	make	1 Mile,	m.
3 Miles	make	1 League,	lea.
69½ Miles	make 1 Degree on the equator,		deg. or o.
360 Degrees	make 1 Great Circle of the earth.		

MARINER'S MEASURE.

XXII. Mariner's measure is long measure chiefly used to measure distances at sea.

TABLE.

12 Lines	make 1 Inch,	in.
4 Inches	make 1 Hand,	hd.
9 Inches	make 1 Span,	sp.
6 Feet	make 1 Fathom,	fm.
120 Fathoms,	make 1 Cable-length,	cl.
7⅓ Cable-lengths	make 1 Mile,	mi.
1 Knot	make 1 11-72 Statute-miles,	st.-m.

CLOTH MEASURE.

XXIII. This measure is used in measuring dry goods.

TABLE.

2¼ Inches	make	1 Nail,	na.
4 Nails	make	1 Quarter of a yard,	qr.
4 Quarters	make	1 Yard,	yd.
3 Quarters	make	1 Ell Flemish,	e. f.
5 Quarters	make	1 Ell English,	e. e.

SURFACE OR SQUARE MEASURE.

XXIV. This measure is used in measuring surfaces of all kinds.

TABLE.

144 Square Inches	make 1 Square Foot,	sq. ft.
9 Square Feet	make 1 Square Yard,	sq. yd.
30¼ Square Yards	make 1 Square Rod or Pole,	sq. rd.
40 Square Rods	make 1 Rood,	r.
4 Roods	make 1 Acre,	a.
640 Acres	make 1 Square Mile,	s. m.

Note.—Surface measure has but two dimensions—length and breath. Hence to find the area or surface, when the two dimensions are given, multiply them together, and the product will be the area required.

Note.—When the area and one of the dimensions are given to find the other.

Rule.—Reduce the area to the same denomination as that of the given dimension, then divide by the given dimension, and the quotient will be the other dimension in the same denomination.

Ex. A farmer wishes to lay off a two-acre lot; he can obtain a line in one direction 20 rods long; what must be the length of the other? Solution. 2 acres=320 rods. 320÷20=16, the other side. Proof, 16×20=320. 320÷160=2 acres.

SURVEYOR'S OR ENGINEER'S MEASURE.

XXV. This measure is a kind of long measure, used in laying out roads, and running the boundaries of land.

TABLE.

7 92-100 Inches	make	1 Link,	L.
4 Rods or 66 Feet	make	1 Chain,	c.
80 Chains,	make	1 Mile,	m.
1 Square Chain,	makes	16 Square Rods,	sq. rd.
10 Square Chains,	make	1 Acre,	a.

CUBIC OR SOLID MEASURE.

XXVI. This measure is used in measuring such bodies or things as have length, breath and thickness; as timber, stone, etc.

TABLE.

1728 Cubic Inches	make 1 Cubic Foot,	cu. ft.
28 Cubic Feet	make 1 Cubic Yard,	cu. yd.
40 Cubic Feet, hewn timber,	make 1 Ton,	t.
16 Cub. Ft. or 50 Ft., round tim.,	make 1 Cord Ft,	c. ft.
8 Cord Feet, or 128 Cubic Ft.,	make 1 Cord of wood,	c.

Note.—Since cubic measure has three dimensions, in order to find the solid contents of a body or capacity of rooms, boxes, &c., multiply the three dimensions together.

Note.—A pile of wood or bark 8 feet long, 4 feet wide, and 4 feet high contains 1 cord, because these dimensions multiplied together are equal to 128 cubic feet.

WINE MEASURE.

XXVII. Wine measure is used for measuring *wine*, and *most liquids.*

TABLE.

4 Gills	make	1 Pint,	pt.
2 Pints	make	1 Quart,	qt.
4 Quarts	make	1 Gallon,	gl.
63 Gallons	make	1 Hogshead,	hhd.
2 Hogsheads	make	1 Pipe,	pi.
2 Pipes	make	1 Ton.	t.

Note.—The number of gallons which a barrel contains is not uniform in all the States; some States having adopted 31½, some 32, and in others varying from 28 to 32.

Note.—The wine gallon contains 231 cubic inches. The imperial gallon of Great Britain contains 277.274; consequently, it takes about 6 gallons of the former, to make 5 of the latter.

ALE OR BEER MEASURE.

XXVIII. This measure is used for measuring *beer*, *ale*, *porter* and *milk*.

TABLE.

2 Pints	make	1 Quart,	qt.
4 Quarts	make	1 Gallon,	gl.
36 Gallons	make	1 Barrel,	bl.
54 Gallons	make	1 Hogshead,	hhd.

Note.—A beer gallon contains 282 cubic inches.

DRY MEASURE.

XXIX. By this measure, are measured all dry wares; as *grain*, *seeds*, *roots*, *fruits*, *salt*, *coal*, *sand*, *oysters*, *&c.*

TABLE.

2 Pints	make	1 Quart,	qt.
8 Quarts	make	1 Peck,	pk.
4 Pecks	make	1 Bushel,	bu.
36 Bushels	make	1 Chaldron,	ch.

Note.—The measure adopted by the United States is called the Winchester bushel; it is a vessel of cylindric form 18½ in. in diameter, 8 in. deep, and contains $2,150\frac{42}{100}$ cubic inches; but the imperial bushel of Great Britain, $2,218\frac{192}{1000}$; so that 32 bushels of the latter, are about equal to 33 of the former.

Note 2.—The number of pounds adopted is not uniform in all the States; some having adopted one number, and some another. A standard bushel of wheat is 60 lbs., of corn shelled 56, corn on the cob 70, rye 56, oats varying from 32 to 33⅓, salt 50, dried fruit variable.

Note 3.—A gallon of dry measure contains $26\frac{4}{5}$ cubic in.

TIME MEASURE.

XXX. This measure is used to measure the various divisions of time, whether natural or artificial.

TABLE.

60 Seconds	make	1 Minute,	min.
60 Minutes	make	1 Hour,	hr.
24 Hours	make	1 Day,	da.
7 Days	make	1 Week,	wk.
4 Weeks	make	1 Month,	mo.
13 Mo., 1 da. 6 hrs., or 365 Days 6 hours	make	1 Julian Year,	yr.
12 Calendar Months	make	1 Year,	yr.

Note 1.—The years are numbered from the beginning of the Christian Era. The year is divided into 12 calendar months numbered from January; the days are numbered from the beginning of the month; hours from 12 o'clock at night to 12 at noon.

Note 2.—The length of the tropical year is 365 days, 5 hours, 48 minutes, 48 seconds nearly.

Note 3.—Since the length of the year is 365 years and 6 hours, the odd 6 hours, by accumulating for 4 years, make a day, so that every fourth year contains 366 days. This is called Bissextile or Leap year. The leap years are exactly divisible by 4: 1872, 1876, 1880, are called leap years.

Note 4.—In business transactions, 30 days are regarded as a month.

CIRCULAR MEASURE.

XXXI. This measure is used to measure latitude and longitude, and the motions of the heavenly bodies, in their respective orbits.

TABLE.

60 Seconds	make	1 Minute,	m.
60 Minutes	make	1 Degree,	deg.
30 Degrees	make	1 Sign,	s.
12 Signs or 360 deg.	make	1 Circle,	c.

Note.—Care should be taken not to confound minutes of space, and minutes of times.

TABLE OF PARTICULARS.

XXXII.	12 Units or things	make	1 Dozen.
	12 Dozen	make	1 Gross.
	12 Gross or 144 doz.	make	1 Great Gross.
	20 Things	make	1 Score.
	100 Pounds	make	1 Quintal of fish.
	196 Pounds	make	1 Barrel of flour.
	200 Pounds	make	1 Barrel of pork.
	18 Inches	make	1 Cubit.
	22 Inches, nearly	make	1 Sacred Cubic.
	14 Pounds of Iron or Lead	make	1 Stone.
	21½ Stones	make	1 Pig.
	8 Pigs	make	1 Fother.

BOOKS AND PAPER.

XXXIII. The terms *quarto*, *folio*, *octavo*, *decimo*, *&c.*, indicate the number of leaves into which a sheet of paper is folded.

TABLE.

A sheet folded in		2	leaves in	called a	folio.
"	"	4	"	"	quarto or 4 mo.
"	"	8	"	"	octavo or 8 mo.
"	"	12	"	"	12 mo.
"	"	16	"	"	16 mo.
"	"	18	"	"	18 mo.
"	"	24	"	"	24 mo.
"	"	32	"	"	32 mo.

24 sheets of paper	make	1 quire.
20 quires	make	1 ream.
2 reams	make	1 bundle.
5 bundles	make	1 ball.

PROPERTIES OF NUMBERS.

XXXIV. 1. Numbers are divided into even and odd.

2. All numbers are even which can be divided by two without remainder; hence 24 and 8 are even numbers; because they can be divided by 2 without a remainder; but 3, 7 and 9 are odd; since they cannot be divided by 2 without a remainder.

3. Numbers again are either prime or composite.

4. A number is prime when it cannot be resolved into factors; as 2, 3 and 5 are prime numbers; because they can not be divided by any number greater than one, and less than themselves.

5. Numbers are composite, when they can be resolved into factors. Ex. 4, 8 and 9 are composite numbers; because they can be resolved into factors.

6. Factors are either composite or prime; thus 5 and 9 are factors of 45; but 9 is a composite factor; because it can be resolved into other factors, viz: two 3's.

Note.—Numbers whether prime or composite, are said to be prime to each other, when they have no common factor.

FACTORING.

XXXV. Factoring consists in resolving a composite number into its prime factor, and depends on the following principles and propositions.

PRINCIPLES.

XXXVI. 1. A factor of a number, is a factor of any multiple of that number.

2. A factor of any two numbers, is also a factor of their sum. From these principles are deduced the following

PROPOSITIONS.

I. *Any number ending in* 0, 2, 4, 6 *or* 8, *is divisible by* 2.

By *implication*, no number is divisible by 2 which does not end in 0, 2, 4, 6 or 8.

II. *Any number is divisible by* 4, *when the number denoted by its two right hand digits, is divisible by* 4.

By *implication*, no number is divisible by 4, unless the number denoted by its two right hand digits, is divisible by 4.

III. *Any number ending in* 0 *or* 5 *is divisible by* 5.

By *implication*, no number which does not end in 0 or 5, is divisible by 5.

IV. *Any number ending* 0, *two* 0's, *etc.*, *is divisible by* 10, 100, *&c.*

V. *Any composite number is divisible by the product of any two or more of its prime factors.*

VI. *Every prime number, except* 2 *and* 5, *ends in* 1, 3, 7 *or* 9.

RULES FOR FACTORING.

XXXVII. To resolve any composite number into its prime factors.

Divide by any prime factors that will divide it without remainder, and continue the operation till all the prime factors are developed.

Ex. Resolve 84 into its prime factors.

Operation, $84 \div 2 = 42 \div 2 = 21 \div 3 = 7$; hence the prime factors are two 2's, a 3, and a 7. Proof, $2 \times 2 \times 3 \times 7 = 84$.

REM. 1. It is better perhaps to commence with the least prime factor.

REM. 2. For practical purposes, it is generally sufficient to resolve the composite numbers into factors, whether composite or prime.

THE GREATEST COMMON DIVISOR OR MEASURE.

XXXVIII. The *greatest common divisor* or *measure*, is the largest number that will divide two or more numbers without remainder.

RULES.

I. *Resolve the given numbers into their prime factors, and, if, there is but one factor common to both or to all, that is the great-*

est common divisor, but, if there are more than one common factor, their product will be the greatest common divisor.

Ex. Find the greatest common divisor of 35 and 49.

Operation. The prime factors of 35 are 5 and 7, and the prime factors of 49, are two 7's, hence 7 is the only factor common to both; it is therefore the greatest common divisor.

Ex. 2. Find the greatest common divisor of 24 and 32.

Operation. The prime factors of 24 are three 2's and one 3, and the prime factors of 32, are five 2's.

Now, by comparing the prime factors of both numbers, we find that three 2's are common to both numbers; hence their product will be the greatest common divisor; thus, $2\times2\times2=8$.

II. *Divide the greater number by the less and the divisor by the remainder; continue the operation till there is no remainder, and the last divisor will be the divisor sought.*

Ex. Find the greatest common divisor of 24 and 98.

Operation. $98\div24=4+2$, $24\div2=12$.

Now, since there is no remainder, 2 the last divisor, is the greatest common divisor.

Note.—If there are more than two numbers, first find the greatest common divisor of two; secondly, find the greatest common divisor of the divisor thus found, and another number, and so on, till all the numbers are exhausted, and the last divisor will be the divisor sought.

SOLUTION OF PROBLEMS.

XXXIX. Ex. A farmer has 12 bushels of Oats, 18 bushels of rye, 24 bushels of corn, and 30 bushels of wheat. Required the largest boxes of uniform size, and containing an

exact number of bushels into which the grain can be put, each kind by itself, and all the boxes to be full, and also the number of boxes necessary to contain the grain?

Ans. 28 boxes containing 3 bushels each.

Solution. Find the greatest common divisor of all the numbers given, and this common divisor will be the size of the box sought, (which in this case is 3); then divide the sum of the given numbers by the greatest common divisor, and the quotient will be the number of boxes sought, thus (12+18+24+30)÷3=28, number of boxes.

Ex. 2. I have 3 fields, one containing 16 acres, the second 20 acres, and the third 24 acres. Required the largest size lots containing each an exact number of acres, into which they can be divided, and the number of lots. Ans. 4 acre lots, and number of lots, 15.

THE LEAST COMMON MULTIPLE.

XL. 1. The *common multiple* of two or more numbers, is a number that can be divided by each of them without a remainder; thus 60 is a common multiple of 3, 4, and 5; because 60 can be divided by each of them without a remainder.

2. The *least common multiple* of two or more numbers, is the least number that can be divided by each of them without a remainder; thus 12 is the least common multiple of 3, 4, and 6; because it can be divided by each of them without remainder.

3. A *multiple* of a number, contains all the prime factors of that number; the *common multiple* of two or more numbers, contains all the prime factors of each of the numbers;

and the *least common multiple* of two or more numbers, contains only each prime factor taken the greatest number of times, it is found in any of the several numbers; hence the least common multiple of two numbers, must be the least number that will contain all the prime factors of them, and no others.

TO FIND THE LEAST COMMON MULTIPLE.

XLI. 1. *Arrange the numbers in a horizontal line.*

2. *Divide by any prime factor that will divide two or more of the numbers without remainder.*

3. *Write the quotient figures together with the undivided numbers, under a line below, and continue the operation, till the quotient figures become prime or prime to each other.*

4. *Multiply the quotient figures and the divisor together, and the product will be the least common multiple.*

Ex. Find the least common multiple of 5, 6 and 9.

Operation. $3\overline{)5.\ 6.\ 9}$
$\quad\quad\quad

utes, and C in 25 minutes. Required the time how long before they come together at the point from which they set out, and how many times each will have walked around it?

Solution. First find the least common multiple of the numbers given, and their common multiple will be the time required in minutes which (in this case) is 300 minutes, 300 ÷5 hours, and then divide the time occupied by each one in walking around, and the quotient will express the number of times of each one respectively; thus, 300÷15=20, A's number of times. 300÷20=15, B's number of times. 300÷25=12, C's number of times.

Problem 2. A can dig 9 rods of a ditch in one day; B 12 rods, in a day; and C 16 rods: what is the smallest number of rods that would afford exact days of labor to each working alone? In what time will each one do the whole work? Ans. 144 rods, 16 days A's time; 12 days B's time, and 9 days C's time.

FRACTIONS.

XLIII. A *fraction* is the expression of one or more equal parts of a unit. Hence the unit is the foundation of all fractions. The expresion of one of the equal parts of a unit, is called the *fractional* unit; as, $\frac{1}{4}$, $\frac{1}{2}$, $\frac{1}{3}$, &c.

TWO KINDS OF FRACTIONS, COMMON AND DECIMAL.

XLIV. A *common fraction* consists of two parts, one written above the other, with a line drawn between them; thus, $\frac{1}{2}$, $\frac{2}{3}$, &c. The relation which the two parts bear to each other, is that of *dividend* and *divisor*, and the line separating them, is one of the signs of division. The figure be-

low the line is called the *denominator;* because it gives name to the fraction, and express the equal number of parts into which the unit has been divided, and the figure above the line, is called the *numerator;* because it expresses the number of fractional units taken into the expression. The *value* of a fraction is the quotient of the numerator divided by the denominator.

From the preceding definitions we deduce the following

PROPOSITIONS.

XLV. I. *If the numerator be multiplied by any number, the denominator remaining unchanged, the value of the fraction will be increased as many times as there are units in the multiplier.*

II. *If the denominator be multiplied, the numerator remaining unchanged, the value of the fraction will be decreased as many times as there are units in the multiplier.*

III. *If the numerator be divided, the denominator remaining unchanged, the value of the fraction will be decreased.*

IV. *If the denominator be divided, the numerator remaining unchanged, the value of the fraction will be increased.*

V. *If both terms of a fraction be multiplied or divided by the same number, the value of the fraction will not be changed.*

From the principles involved in the preceding propositions, we deduce the following

RULES.

XLVI. 1. To reduce a fraction to its lowest terms, *divide both terms of the fraction by any number that will divide them without remainder, and continue the operation till they*

become prime to each other; the fraction will then be to its lowest terms.

Ex. Reduce $\frac{28}{42}$ to its lowest terms: divide both terms of this fraction by $7 = \frac{4}{6} \div 2 = \frac{2}{3}$.

2. To multiply a fraction by a whole number, *either multiply the numerator or divide the denominator, when this can be done without remainder.*

3. To multiply a fraction by a fraction, *multiply the numerators together for the numerator of the product, and the denominators together for the denominator of the product.*

Ex. Multiply $\frac{3}{4}$ by $\frac{2}{3}$. Operation. $\frac{3}{4} \times \frac{2}{3} = \frac{6}{12} = \frac{1}{2}$.

The same result will be obtained, if we divide the terms of the multiplicand by the terms of the multiplier inverted. Now, let us divide $\frac{3}{4}$ by $\frac{2}{3}$ with its terms inverted $(\frac{3}{2})$; thus, $\frac{3}{4} \div \frac{3}{2} = \frac{1}{2}$; hence the result is the same.

4. To divide a fraction by a whole number, *either divide the numerator or multiply the denominator.*

5. To divide a fraction by a fraction, *invert the terms of the divisor, and proceed as in multiplication, or divide the terms of the dividend by the terms of the divisor, when it can be done without remainder;* thus, divide $\frac{8}{9}$ by $\frac{4}{3}$. Operation. $\frac{8 \div 4}{9 \div 3} = \frac{2}{3}$.

Note.—It will readily be perceived that, if the multiplier is a proper fraction, the product will be less than the multiplicand, and, on the other hand, if the divisor is a proper fraction, the quotient must be greater than the dividend.

Note.—The invertion of the terms of the divisor, is only done as a matter of convenience; since, as we have seen, the same result will be obtained, if we divide both terms of the dividend by the corresponding terms of the divisor; this, however, can only be done, when the division can be effected without a remainder.

THE DIFFERENT KINDS OF FRACTIONS

XLVII. 1. A fraction is *proper*, when its value is *less* than a unit: as, $\frac{1}{2}$, $\frac{2}{3}$, $\frac{1}{4}$, &c.

2. A fraction is *improper*, when its value is *equal to* or *greater* than a unit; as, $\frac{4}{4}$, $\frac{5}{2}$, &c.

3. A *simple fraction* is a single expression; it may be proper or improper; as, $\frac{2}{3}$, $\frac{7}{5}$, &c.

4. A *mixed number* consists of an integral number, and a fraction; as, $3\frac{2}{3}$, &c.

5. A *compound fraction* is a fraction of a fraction united by of or $\times$ as $\frac{3}{5}$ of $\frac{3}{4}$ of $\frac{1}{2}$, or $\frac{2}{3}\times\frac{4}{7}$, &c.

6. A *complex fraction* is a fraction having a fractional numerator or denominator or both; as, $\frac{\frac{2}{4}}{\frac{3}{4}}$, $\frac{3\frac{1}{2}}{2\frac{2}{3}}$, &c.

Note.—The term complex applied to fractions, is only admissible as a matter of convenience; since the relation which the two terms bear to each other, is that of dividend and divisor; hence a complex expression expresses nothing more than the division of a fraction.

REDUCTION OF FRACTIONS.

XLVIII. 1. The *reduction* of fractions consists in changing their *form* without affecting their *value*.

1. TO REDUCE AN IMPROPER FRACTION TO A WHOLE OR MIXED NUMBER.

1. *Divide the numerator by the denominator.*

Ex. Reduce $\frac{15}{4}$ to a mixed number. Operation. $\frac{15}{4}=3\frac{3}{4}$.

2. TO REDUCE A MIXED NUMBER TO AN IMPROPER FRACTION.

Rule.—Multiply the whole number by the denominator, and to the product, add the numerator; this amount written over the denominator is the result required.

Ex. What improper fraction is equal to $3\frac{2}{3}$?

Operation, $3\frac{2}{3}=\frac{11}{3}$.

Rem. The reason of this rule is obvious; for, as one unit has been divided into as many parts as indicated by the denominator, all the other units must be divided into the same number of parts, and this is done by multiplying the whole number by the denominator, for instance in the example above, one unit has been divided into three parts, and the other three expressed by the integral number divided into the same number of parts, will be $\frac{9}{3}$, and since there are two fractional units expressed by the numerators, it follows that $\frac{9}{3}+\frac{2}{3}=\frac{11}{3}$.

3. TO REDUCE A COMPOUND FRACTION TO A SIMPLE ONE.

Rule.—Multiply all the numerators together for the numerator of the simple fraction, and all the denominators together for the denominator.

Ex. Reduce $\frac{1}{2}$ of $\frac{2}{3}$ of $\frac{3}{4}$ to a simple fraction.

Operation. $\frac{1}{2}$ of $\frac{2}{3}$ of $\frac{3}{4}=\frac{6}{24}=\frac{1}{4}$.

4. TO REDUCE A COMPLEX FRACTION TO A SIMPLE FRACTION.

Rule.—Invert the terms of the denominator as directed in the division of fraction.

Ex. Reduce $\frac{1\frac{1}{3}}{1\frac{1}{2}}$ to a simple fraction.

Operation. $\frac{1\frac{1}{3}}{1\frac{1}{2}}=\frac{\frac{4}{3}}{\frac{3}{2}}=\frac{8}{9}$.

Note.—This operation is proved by multiplying the simple fraction by the denominator, which will give the numerator, and, by dividing the numerator by the simple fraction, it will give the denominator; thus, $\frac{8}{9}\times\frac{3}{2}=\frac{24}{18}=\frac{4}{3}=1\frac{1}{3}$, again $\frac{4}{3}\div\frac{9}{8}=\frac{36}{24}=\frac{3}{2}=1\frac{1}{2}$. (See proof of division).

5. TO REDUCE FRACTIONS OF DIFFERENT DENOMINATORS TO A COMMON DENOMINATOR.

II. *Multiply each numerator by all the denominators, except its own, for the numerators required, and multiply all the denominators together for a common denominator, and then each numerator written over the common denominator, it will be the reduction required.*

Ex. Reduce $\frac{1}{2}$, $\frac{2}{3}$, $\frac{3}{5}$ to a common denominator.

Operation. $1\times3\times5=15$, $2\times2\times5=20$, $3\times2\times3=18$; denominators, $2\times3\times5=30$, expressed thus, $\frac{15}{30}$, $\frac{20}{30}$ and $\frac{18}{30}$.

II. *Divide the common denominator by each given denominator respectively, and multiply the quotient by the numerator;* thus 30 being the common denominator in the preceding example. $30\div2=15\times1=15$, $30\div3=10\times2=20$, $30\div5=6\times3=18$, expressed $\frac{15}{30}$, $\frac{20}{30}$ and $\frac{18}{30}$, the same as before.

III. *Multiply both terms of the fraction by any number or numbers that will make their denominators alike.*

Ex. Reduce $\frac{2}{3}$ and $\frac{3}{4}$ to a common denominator.

Now, if we multiply both terms of $\frac{2}{3}$ by 4, the result will be $\frac{8}{12}$; again, if we multiply both terms of $\frac{3}{4}$ by 3, the result will be $\frac{9}{12}$—the denominators are now alike. This last method is called reduction by *inspection*, and often facilities the operation. Each method may be proved by reducing the fractions to their lowest terms.

Note.—The value of the fractions is not changed in any of the preceding methods; because both terms of the fraction have been virtually multiplied by the same numbers. (See Proposition, 5.)

TO FIND THE LEAST COMMON DENOMINATOR.

XLIX. I. *Reduce all the fractions to their lowest terms.*

II. *Find the least common multiple of the denominators, and then proceed as in method second.* (See least common multiple.)

DECIMAL FRACTIONS.

L. 1. A decimal fraction is a fractional expression, in which the denominator is generally omitted, and a period (.), called a separatrix, is placed before the numerator.

Rem. The limits of this work will not allow us to do more than briefly state a few of the most important principles, and rules involved in decimal operations.

2. In decimal fractions, a unit is divided into ten equal parts called tenths; and these again into ten other parts called hundredths, and these again into ten other equal parts called thousandths, and so on.

3. Decimal fractions follow the same laws of increase and diminution as integral numbers; hence they may be conveniently expressed together, and the expression is then called a mixed number; as, 5.5, read five and five tenths.

4. The denominator consists of one and as may naughts annexed, as there are decimal figures in the numerator.

5. The value of a decimal fraction can never equal that of a unit, however, far extended.

6. The value of a fraction is diminished tenfold by *pre-*

fixing a naught to it; but its value is not affected by *annexing* a naught.

7. All the operations in decimal fractions are performed as in integral numbers, the only difficulty is in knowing, where to place the separatrix; this, for the most part, will be obviated by observing the following

RULES.

LI. I. *Separate on the right hand of the product as many decimal figures as there are in both factors.*

Ex. Multiply 5.3 by .5.

Operation. $5.3 \times .5 = 2.65$.

Note.—If there are not enough places in the product, prefix naughts; thus, $.05 \times .3 = .015$.

II. *Separate on the right hand of the quotient as many decimal figures as will equal the excess of decimal places in the dividend.*

Ex. Divide .25 by .5.

Operation. $.25 \div .5 = .5$.

III. *If the decimal places in the divisor exceed those in the dividend, annex enough ciphers to make them equal, and in this and every other case, where the number of decimal places are equal, the quotient will be integers.*

Note.—If it is necessary to annex more ciphers to the dividend, as in case of a remainder, separate as directed in rule second; for every cipher annexed, makes an additional decimal in the dividend.

REDUCTION OF DECIMALS.

LII. 1. To reduce a decimal to a common fraction.

Note I.—Supply the denominator, and reduce it to its lowest terms.

Ex. Reduce .25 to a common fraction; thus, $\frac{25}{100}=\frac{1}{4}$.

Note.—If the decimal is a repetend, reduce the complex expression to the form of an improper fraction, and the following rule will be sufficient.

Rule II.—Reduce the complex expression to the form of an improper fraction, and divide by 10, 100, 1000, *&c., as the decimals may be tenths, hundredths, thousandths, &c., and the quotient will be a common fraction of equal value.*

Ex., first. Reduce $.1\frac{3}{7}$ to a common fraction.

Operation. $.1\frac{3}{7}=\frac{10}{7}\div 10=\frac{1}{7}$.

Ex., second. Reduce $.66\frac{2}{3}$ to a common fraction.

Operation. $.66\frac{2}{3}=\frac{200}{3}\div 100=\frac{2}{3}$.

Ex., third. Reduce $.833\frac{1}{3}$ to a common fraction.

Operation. $.833\frac{1}{3}=\frac{2500}{3}\div 1000=\frac{2500}{3000}=\frac{5}{6}$.

To reduce a common fraction to decimal.

Rule III.—Annex ciphers to the numerator, and divide by the denominator, and continue the operation till there is no remainder, or till it become a repetend; in this case 3 *or* 4 *places are sufficient.*

Ex. Reduce $\frac{3}{8}$ to an equal decimal.

Operation. $\frac{3000}{8}=.375$. Proof. $\frac{375}{1000}=\frac{3}{8}$.

Note.—Fractional operations are for the most part, proved as similar operations in integral numbers.

DECIMAL CURRENCY.

LIII. Dollars, cents, and mills may be called decimal currency; since regarding the dollar as a unit, cents ex-

press hundredths of dollars, and mills thousands of dollars or tenths of cents; hence the same rules and principles apply to decimal currency as to other decimal expressions.

METALLIC CURRENCY.

LIV. The metallic currency of the United States, consists of gold, silver and nickel coins, (the last formerly called copper). The legal gold coins are double eagle, eagle, half-eagle, quarter-eagle, three-dollar piece, and one dollar; the legal silver coins are the dollar, half-dollar, quarter-dollar, dime, half dime and three-cent piece; a nickel is the cent.

Note.—There are, however, in circulation fifty-dollar piece, half-dollar piece and quarter-dollar piece, though they are not legal; the cent and half-cent, though still in use, are no longer coined.

Note.—Decimal currency is only used in accounts, the cents occupying two decimal places; consequently, where a less number than ten is to be expressed, a cipher is put in place of dimes; thus, .09 equal 9 cents.

Note.—The mill has no coin corresponding to its value; in business transactions, no regard is paid to parts of mills, and, when five or more go over from cents, business men regard it as one cent; but, if less than five, no attention is paid to it.

DUODECIMALS.

LV. *Duodecimals* are a kind of denominate numbers whose radix is 12, i.e. twelve of a lower denomination, make one of the next higher denomination; consequently, if we divide a unit of a higher denomination into 12 equal parts, one 12 will be equal to a unit of the next lower denomination; regarding one foot as the unit, if it be divided into 12 equal parts, one part will be equal to one prime or inch,

and, if we divide this into 12 other equal parts, one part will be equal to one second; hence one inch is one 12th of a foot, and one second is equal to one 12th of one 12th, equal to $\frac{1}{144}$th of a foot.

The lower denominations are distinguished by marks affixed to them, called indices; thus, 1,' 2," 3,''' and so on, is read two primes, two seconds, two thirds and so on.

Note 1.—Since the operations in duodecimals, are similar to other denominate numbers, we deem it unnecessary to give any example.

Note 2.—Operations may frequently be facilitated by reducing primes to the fraction of a foot.

Note 3.—Duodecimal fractions, as they are sometimes called, are applicable to linear, surface and cubic measure.

ANALYSIS.

LVI. Analysis is the examination of the several parts of a proposition or problem, and tracing the relation which these parts bear to each other, and to the whole, and also ascertaining the part which each element is to act or the use which is to be made of it, in the solution.

The operation consists of a series of steps which generally bear the relation to each other, of cause and effect, or antecedents and sequence. Such a process resembles one ascending a flight of stairs, with a lighted candle in his hand; as he ascends, the light continues to fall before him, so that the last steps will be as luminous as the first.

We generally reason from a given number to a unit, and from that to the number required (i. e.) we ascertain what part of the given effect a single unit of the given cause, in the shortest period of time indicated, has or can produce,

having ascertained this fact the rest of the process comes easy; since it is supposed that the units of some other cause, connected with the preceding one, are equally potent.

Ex. If 3 men, in 5 days, can grade 45 feet of road, how many feet can 5 men in 4 days grade? Ans. 60 feet.

Analysis. Now since 3 men can grade 45 feet, it follows that one man, in the same time, can only grade one-third of 45 feet; thus, $45 \div 3 = 15$, what one man can do in five days; by consequence, he can only do, in one day, one-fifth of 15, $15 \div 5 = 3$ feet. Now since one man, in one day, can grade 3 feet, 5 men can grade 5 times $3 = 15$ feet, and that, in 4 days, four times $15 = 60$.

Proof.—The correctness of such operations, may be proved by dividing each effect by its own cause, if correct, the ratios or quotients, must be equal; since each quotient or quotients must express what a single unit of each cause in the same time produces; thus, $45 \div (3 \times 5) = 3$, and that $60 \div (5 \times 4) = 3$.

Rem. The solution of the preceding problem, involves four steps: the first leads to what one man can do in the specified time, the second to what one man can do in one day, the third to what 5 men can do in one day, and the fourth to what 5 men can do in four days.

Ex. 2. If a family of 7 persons, consume one barrel of flour in 12 days, required the quantity of flour that would be sufficient for 42 persons in 14 days? Ans. 7.

Operation, $1 \div 7 = \frac{1}{7} \div 12 = \frac{1}{84} \times 42 = \frac{42}{84} = \frac{1}{2} \times 14 = \frac{14}{2} = 7$.

Rem. Analysis is of vast importance; since almost any problem may be solved by it, and since, in a great measure, it supercedes the necessity of remembering rules.

ABRIDGED FORMS OF OPERATIONS.—GENERAL RULES.

LVII. *Rule I.—Perform the operation mentally when practicable; for the mind acts more rapidly than words can be uttered or figures made.*

II. Perform the operation by reading the numbers instead of the common routine.

Note.—In reading numbers, only mention each partial amount in addition, and in multiplication, only name the right hand figure of each partial product increased by the number carried, except the last product which should be all expressed; thus: instead of saying 8 and 4 are 12, and 5 are 17, and 4 are 21, and 6 are 27, &c., read 12, 17, 21, 27, &c. Again, in the following Ex., require the product of 4325×5. Now instead of saying 5 times 4 are 20, 5 times 2 are 10, and 2 are 12, 5 times 3 are 15, and 1 are 16, 5 times 4 are 20, and 1 is 21, read 0, 2, 6, 21.

III. Cancel like factors from the dividend and divisor when obvious; since this will not change the relation of the numbers to each other, nor effect the value of the quotient

IV. Reduce such fractions as many occur in the operation to their lowest terms.

V. Reduce fractions of different denominators to a common denominator, by inspection, when this can be done.

VI. In percentage use the unit (1) *and common fraction instead of the hundred* (100) *and decimal fraction; since the results must be the same; but an operation by the former method, can be performed in a much shorter time than one by the latter.*

VII. Multiply and divide by the aliquot parts of a dollar, instead of the decimal number, in performing operations in decimal currency or in United States money.

VIII. When the multiplicand is a common fraction, and the multiplier an integer, divide the denominator (when it can be done without remainder,) instead of multiplying the numerator.

IX. Divide each term of the fractional dividend by the corresponding terms of the divisor, (when it can be done without remainder,) instead of inverting its terms and multiplying.

Ex. Divide $\frac{8}{9}$ by $\frac{2}{3}$. $\frac{8 \div 2}{9 \div 3} = \frac{4}{3}$. Again with the terms inverted $\frac{8 \cdot 3}{9 \cdot 2} = \frac{24}{18} = \frac{4}{3}$.

Note.—If the aliquot part is a fractional unit, in multiplication, divide the multiplicand by the denominator of the fraction, and in division, multiply the dividend by the denominator of the fraction. (See table of aliquot parts.)

TABLE OF ALIQUOT PARTS.

LVIII.

Cents equal to	$
5	$\frac{1}{20}$
$6\frac{1}{4}$	$\frac{1}{16}$
$8\frac{1}{3}$	$\frac{1}{12}$
10	$\frac{1}{10}$
$12\frac{1}{2}$	$\frac{1}{8}$
$16\frac{2}{3}$	$\frac{1}{6}$
$18\frac{3}{4}$	$\frac{3}{16}$
20	$\frac{1}{5}$
25	$\frac{1}{4}$
$31\frac{1}{4}$	$\frac{5}{16}$
$33\frac{1}{3}$	$\frac{1}{3}$
$37\frac{1}{2}$	$\frac{3}{8}$
40	$\frac{2}{5}$
50	$\frac{1}{2}$
$56\frac{1}{4}$	$\frac{9}{16}$
$58\frac{1}{3}$	$\frac{7}{12}$
60	$\frac{3}{5}$

$62\frac{1}{2}$	"	"	$\frac{5}{8}$
$66\frac{2}{3}$	"	"	$\frac{2}{3}$
$67\frac{1}{2}$	"	"	$\frac{27}{40}$
75	"	"	$\frac{3}{4}$
$83\frac{1}{3}$	"	"	$\frac{5}{6}$
$87\frac{1}{2}$	"	"	$\frac{7}{8}$

EXAMPLES FOR PRACTICE.

LIX. Ex. 1. What will 150 yards of cloth come to at 25 cents a yard?

Analysis. Now since 25 cents is equal to $\frac{1}{4}$ of a dollar, the cost of one yard, there will be only $\frac{1}{4}$ as many dollars as yards; hence, $150 \div 4 = 37\frac{1}{2}$. Again, if I pay $37\frac{1}{2}$ dollars for cloth at $\frac{1}{4}$ of a dollar per yard, how many yards did I buy? Now since the cost of one yard is $\frac{1}{4}$ of a dollar, it follows that there must be 4 times as many yards as dollars; hence, $37\frac{1}{2}$ multiplied by 4 equal 150 yards. Again, if I pay $37\frac{1}{2}$ dollars for 150 yards; what did it cost per yard? Now it is obvious that the cost of one yard is 150th of $37\frac{1}{2}$; hence $37\frac{1}{2} \div 150 = \frac{1}{4} = .25$.

Note.—Though, in the first operation, we divided by 4, the effect is just the same as multiplying by $\frac{1}{4}$, and in the second operation, we multiply by 4, the effect is just the same as dividing by $\frac{1}{4}$. (See note under Rule 2).

Note 2.—It will be observed that the two last operations prove the first.

Ex. 2. What will 330 yards of sheeting amount to at $16\frac{2}{3}$ cents a yard. Operation, $330 \times \frac{1}{6} = 55$ dollars. Proof, paid 55 dollars for sheeting at $16\frac{2}{3}$ cents per yard, required the number of yards? Operation, $55 \div \frac{1}{6} = 330$.

3. What will 64 yards of calico amount to at $12\frac{1}{2}$ cents a yard?

4. Paid 4½ dollars for lining at 8⅓ cents per yard, required the number of yards bought?

5. What is the cost of 87 bushels of potatoes at 37½ cents per bushel?

6. What will 16 lbs. of candles come to at 31¼ cents per pound?

Let other examples be supplied.

X. *Cut off all useless decimals.*

Note.—In business transactions decimals need not be extended beyond two places, or three at most.

XI. *Students should be familiar with Arithmetical language, and with all the rules, and tables used to facilitate operations.*

XII. *Keep the attention firmly fixed on the operation in hand.*

SPECIAL RULES.—ADDITION.

LX. *Add two columns at once.*

Note.—In performing operations in this way, carry, as it is called, one for each hundred, and not one for each ten. The reason of this will be obvious to every *thinking* student.

Rem. This, at first, may appear to students awkward and cumbersome; but let them not despair; but persevere, and rough places will become smooth, and mountains plains. The most expert accountants generally perform in this way.

ABRIDGED METHODS OF MULTIPLICATION.—SPECIAL RULES.

LXI. When naughts occur on the right hand of either factor or both.

Rule I.—Multiply the digits together, and, to their product, annex all the naughts.

Ex. Multiply 240 by 30.

Operation, 24,0
3,0

7200

WHEN THE MULTIPLIER IS 10, 100, 1000, &c.

II. Annex all the ciphers in the multiplier to the multiplicand, and this will complete the product.

IF THE MULTIPLICAND IS A DECIMAL.

III. Remove it as many places towards the left as there are naughts in the multiplier.

Ex. .5×10=5. Now, by moving, 5 one place farther toward the left, it becomes an integral number.

WHEN EITHER FACTOR IS A COMPOSITE NUMBER.

IV. Multiply by its factors instead of the number itself.

Ex. 47×35. 35 being a composite number, we multiply by its factors 7 and 5; thus, 47×7=329×5=1645.

Note.—By strictly observing this method much time will be saved; since no addition is required.

WHEN THE MULTIPLIER IS A LITTLE LESS THAN 10, 100, 1000, &c.

V. Annex to the multiplicand as many ciphers as there are figures in the multiplier, and from the result subtract the product of the multiplicand, by the number the multiplier lacks of being 10, 100, 1000, *&c.*

Ex. Multiply 4232×98.

Operation, first multiply the multiplicand by 2, the number the multiplier wants of being a hundred; thus, 4232×2 =8464; second, subtract this from the multiplicand with two ciphers annexed, 423200—8464=414836. Ans.

Note.—This operation may be proved by multiplying the factors together in the usual way, and the final results will be the same.

VI. Multiply two figures of the multiplicand at once.

Ex. Let it be required to multiply 1225×6.

Operation, 1225
6
7350

Now, instead of saying 6 times 5, &c., say, or rather think, 6 times 25 is 150, and 6 times 12 are 72 and 1 is 73.

Rem. By this method the operation can be performed more rapidly than figures can be made, and to have full command of it, the pupils need only be thoroughly drilled in the extended multiplication table (which see).

Note.—It will be observed that in performing operations as directed above, that two right hand figures are set down instead of one—in other words, carry for hundreds, thousands, and none for tens.

THE EXTENDED MULTIPLICATION TABLE.

2 × 13 = 26	3 × 13 = 39	4 × 13 = 52
2 " 14 " 28	3 " 14 " 42	4 " 14 " 56
2 " 15 " 30	3 " 15 " 45	4 " 15 " 60
2 " 16 " 32	3 " 16 " 48	4 " 16 " 64
2 " 17 " 34	3 " 17 " 51	4 " 17 " 68
2 " 18 " 36	3 " 18 " 54	4 " 18 " 72
2 " 19 " 38	3 " 19 " 57	4 " 19 " 76
2 " 20 " 40	3 " 20 " 60	4 " 20 " 80

5 × 13 = 65	6 × 13 = 78	7 × 13 = 91
5 " 14 " 70	6 " 14 " 84	7 " 14 " 98
5 " 15 " 75	6 " 15 " 90	7 " 15 " 105
5 " 16 " 80	6 " 16 " 96	7 " 16 " 112
5 " 17 " 85	6 " 17 " 102	7 " 17 " 119
5 " 18 " 90	6 " 18 " 108	7 " 18 " 126
5 " 19 " 95	6 " 19 " 114	7 " 19 " 133
5 " 20 " 100	6 " 20 " 120	7 " 20 " 140

8 × 13 = 104	9 × 13 = 117	10 × 13 = 130
8 " 14 " 112	9 " 14 " 126	10 " 14 " 140
8 " 15 " 120	9 " 15 " 135	10 " 15 " 150
8 " 16 " 128	9 " 16 " 144	10 " 16 " 160
8 " 17 " 136	9 " 17 " 153	10 " 17 " 170
8 " 18 " 144	9 " 18 " 162	10 " 18 " 180
8 " 19 " 152	9 " 19 " 171	10 " 19 " 190
8 " 20 " 160	9 " 20 " 180	10 " 20 " 200

11 × 13 = 143	12 × 13 = 156
11 " 14 " 154	12 " 14 " 168
11 " 15 " 165	12 " 15 " 180
11 " 16 " 176	12 " 16 " 192
11 " 17 " 187	12 " 17 " 204
11 " 18 " 198	12 " 18 " 216
11 " 19 " 209	12 " 19 " 228
11 " 20 " 220	12 " 20 " 240

REM. This table might be extended to a hundred or even beyond that; but our limits will not allow us to insert more.

Note.—The science involved in the multiplication table is this, if we begin at the smallest product, and add the multiplying figure to it, the amount will be the next succeeding product, and so on through the entire ascending series; but, if we begin at the largest product, and subtract the multiplying figure from it, the difference will be the next succeeding product, and so on through the entire descending series, or what is called repeating the multiplication table backwards.

REM. Operations in multiplication may also be facilitated by a mental process called *inspection*, by noting the right hand figure (which will generally suggest the left) of each product arising from multiplying together any two digits, without going through the ordinary process of multiplying each figure separately.

LXII. The following table exhibits the product arising from multiplying any two of the nine digits as factors.

Factors	Pro	Factors	Pro	Factors	Pro	Factors	Pro
2 x 1 =	2	3 x 1 =	3	4 x 1 =	4	5 x 1 =	5
2 " 2 "	4	3 " 2 "	6	4 " 2 "	8	5 " 2 "	10
2 " 3 "	6	3 " 3 "	9	4 " 3 "	12	5 " 3 "	15
2 " 4 "	8	3 " 4 "	12	4 " 4 "	16	5 " 4 "	20
2 " 5 "	10	3 " 5 "	15	4 " 5 "	20	5 " 5 "	25
2 " 6 "	12	3 " 6 "	18	4 " 6 "	24	5 " 6 "	30
2 " 7 "	14	3 " 7 "	21	4 " 7 "	28	5 " 7 "	35
2 " 8 "	16	3 " 8 "	24	4 " 8 "	32	5 " 8 "	40
2 " 9 "	18	3 " 9 "	27	4 " 9 "	36	5 " 9 "	45
2 " 10 "	20	3 " 10 "	30	4 " 10 "	40	5 " 10 "	50
2 " 11 "	22	3 " 11 "	33	4 " 11 "	44	5 " 11 "	55
2 " 12 "	24	3 " 12 "	36	4 " 12 "	48	5 " 12 "	60

Factors	Pro	Factors	Pro	Factors	Pro	Factors	Pro
6 x 1 =	6	7 x 1 =	7	8 x 1 =	8	9 x 1 =	9
6 " 2 "	12	7 " 2 "	14	8 " 2 "	16	9 " 2 "	18
6 " 3 "	18	7 " 3 "	21	8 " 3 "	24	9 " 3 "	27
6 " 4 "	24	7 " 4 "	28	8 " 4 "	32	9 " 4 "	36
6 " 5 "	30	7 " 5 "	35	8 " 5 "	40	9 " 5 "	45
6 " 6 "	36	7 " 6 "	42	8 " 6 "	48	9 " 6 "	54
6 " 7 "	42	7 " 7 "	49	8 " 7 "	56	9 " 7 "	63
6 " 8 "	48	7 " 8 "	56	8 " 8 "	64	9 " 8 "	72
6 " 9 "	54	7 " 9 "	63	8 " 9 "	72	9 " 9 "	81
6 " 10 "	60	7 " 10 "	70	8 " 10 "	80	9 " 10 "	90
6 " 11 "	66	7 " 11 "	77	8 " 11 "	88	9 " 11 "	99
6 " 12 "	72	7 " 12 "	84	8 " 12 "	96	9 " 12 "	108

Factors	Pro	Factors	Pro	Factors	Pro
10 x 1 =	10	11 x 1 =	11	12 x 1 =	12
10 " 2 "	20	11 " 2 "	22	12 " 2 "	24
10 " 3 "	30	11 " 3 "	33	12 " 3 "	36
10 " 4 "	40	11 " 4 "	44	12 " 4 "	48
10 " 5 "	50	11 " 5 "	55	12 " 5 "	60
10 " 6 "	60	11 " 6 "	66	12 " 6 "	72
10 " 7 "	70	11 " 7 "	77	12 " 7 "	84
10 " 8 "	80	11 " 8 "	88	12 " 8 "	96
10 " 9 "	90	11 " 9 "	99	12 " 9 "	108
10 " 10 "	100	11 " 10 "	110	12 " 10 "	120
10 " 11 "	110	11 " 11 "	121	12 " 11 "	132
10 " 12 "	120	11 " 12 "	132	12 " 12 "	144

Note.—The numbers 10, 11 and 12 are added to make this a common multiplication table.

ABRIDGED FORMS OF OPERATION IN DIVISION.

SPECIAL RULES.

LXIII. Rule I. *Separate an equal number of naughts on the right of the dividend and divisor when they occur.*

Ex. Divide 240 by 30.

Operation, $24,0 \div 3,0 = 8$.

Note.—It is obvious that the quotient is not changed, since separating the naughts from both terms is dividing both by the same number, consequently 24 will contain 3 as many times as 240 will contain 30.

WHEN NAUGHTS OCCUR ON THE RIGHT HAND OF THE DIVIDEND ONLY.

II. *Separate as many figures on the right hand of the dividend as there are naughts on the right of the divisor, and proceed as before.*

Ex. Divide 675 by 40.

Operation, $67,5 \div 4,0 = 16 + \frac{35}{40} = \frac{7}{8}$.

Note.—If there is no remainder in the operation, the figure or figures are the true remainder; but, if there is a remainder, it must be prefixed to the separated figure or figures.

WHEN THE DIVISOR IS A COMPOSITE NUMBER.

III. *Divide the dividend by one of the factors, and the quotient by the other, and the last quotient will be the one sought.*

Ex. Let it be required to divide 568 by 18.

Ans. 31+10.

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Operation, 568÷6=94+4, 94÷3=31+1, 6+1+4=10 remainder.

Note 1.—If there is a remainder in the first operation, and none in the second, it is the true remainder.

2. If there is a remainder in the second operation, and none in the first, the product of this remainder into the first factor used is the true remainder.

3. If there is a remainder in both operations, the product of the last remainder into the first divisor, plus the first remainder, will be the true remainder. (See the operation above.)

IV. *Perform the operations by short division, when practicable.*

Note 1.—It is generally practicable when the divisor contains but two figures.

Note 2.—If the divisor is a composite number, proceed as in rule III; but, if a prime number, proceed as if it were 12 or less.

Ex. Let it be required to divide 3825 by 17.

Operation, 17)3825

225 Ans.

Rem. No one will find any difficulty in operations similar to the preceding one, who is well acquainted with the multiplication table extended; and, in many cases time will be saved by dividing by the entire number, *even* when composite. For abridged forms of operations in interest, *see interest.*

PERCENTAGE.

LXIV. *Percentage* means by the hundred, and is applicable to anything reckoned by the hundred.

Percentage may be divided into two grand divisions, viz: percentage *without* time, and percentage *with* time. Both these taken together embrace all of what is called the business part of Arithmetic.

LXV. Percentage without time, may be divided into two parts, viz: 1st. Where the per cent. is *less* than a hundred (100,) and 2d. Where *more* than a hundred (100.)

1st. *Per cent. less than a hundred* (100.)

TERMS.

Basis, *Rate Per Cent.*, *Percentage*, the *Amount* and *Difference.*

Note.—The *amount* and *difference* are sometimes called the *result* and *number.*

DEFINITIONS.

1. The *basis* is the standard of comparison, and represents the *buying price* or *cost* of an article.

2. The *rate per cent.* expresses what part of the hundred is to be taken, e. g. six per cent. is six of a hundred, or six hundredths.

3. *Percentage* expresses the aggregate amount of the part of each 100 contained in the basis as indicated by the rate per cent.

4. The *amount* consists of the *basis*+the *percentage*, and represents the selling price when there is a gain.

5. The *difference* consists of the *basis*—the *percentage*, and represents the selling price when there is a loss.

Note 1.—The basis as the standard of comparison, is regarded as being 100 per cent.

Note 2.—Any two of the above terms being given, the third can be found.

THE BASIS AND RATE PER CENT. BEING GIVEN TO FIND THE PERCENTAGE.

LXVI. What is the percentage of 25 dollars, rate per cent. 20 ? Ans. $5.

Analysis. Now since the rate per cent. expresses the part to be taken of 100, 20 must be taken as many times as there are hundred in the basis; then 20 must be taken 25 times, since each dollar is equal to 100 cents; thus, $25\times20=5.00$; hence the follwing:

Rule I.—Multiply the basis by the rate per cent., and cut off according to the rules of decimals.

Ex. What is the percentage of $500 at 25 per cent.?

Operation, $500\times25=\$125$.

Proof. Divide the percentage by the basis, and the quotient will be the rate per cent.; thus, $\$125\div\$500=25$ rate per cent.

Note 1.—The reason of this is, the per centage is the product of the basis multiplied by the rate per cent., and, if we divide the product by one of the factors, the quotient must be the other.

Note 2.—When the per cent. is an aliquot part of 100, the operations may be very much abridged by dividing the basis by the denominator of the fraction which, in effect, is multiplication; thus, $25=\frac{1}{4}$, $500\times\frac{1}{4}=125$. (See table of aliquot parts.)

Rem. In all such operations, the aliquot part of 100 will be used instead of the decimal expression, when practicable.

EXAMPLES FOR PRACTICE.

1. What is the income of a house and lot worth $2325, rented at 15 per cent ?

Ans. $348.75.

2. In an orchard containing 930 trees, 20 per cent. of them being pear trees, how many pear trees are there?

Ans. 186.

3. The ornamental work of a certain edifice, worth $3325, was 16⅔ per cent. of the whole cost; what is the cost of the ornamental work?

Ans. $554.16⅔.

THE RATE PER CENT. AND PERCENTAGE BEING GIVEN TO FIND THE BASIS.

LXVII. Ex. A certain traveler paid his hotel bill with $1.75, which was 5 per cent. of all the money he had; how much did he have?

Ans. $35.00.

Analysis. Now, since the percentage is the product arising by multiplying the basis by the rate per cent., it folows, as the per cent. is one factor, that if we divide the percentage by the rate per cent., the quotient will be the basis ; thus, $1.75÷5=35 dollars; hence we have

Rule II.—*Make the decimal places in the dividend and divisor equal, and divide the percentage by the rate per cent., and the quotient will be the basis.*

Ex. A certain drover sold 200 head of hogs, which was 20 per cent. of his entire drove; how many did he have ?

Operation, 200÷$\frac{1}{5}$=1000 hogs.

Note.—As the rate per cent. always contains two decimal places, if there are no decimal places in the percentage two naughts must be annexed to make the decimal places equal; the quotient will then be whole numbers; but, if the rate per cent. is an aliquot part of a hundred, no naughts need be annexed; as in the example above.

Proof. Find the per centage on the basis by rule I., and

if the work is correct, it will be equal to the given percentage; thus, 1000+.20=200.

EXAMPLES TO BE SOLVED.

1. A merchant paid out 850 dollars for groceries, which was 25 per cent. of his capital; what was his capital?

Ans. $3400.

2. A's annual income is $300, his rate per cent. being 15. His capital required?

Ans. $2000.

3. A certain farmer sold 225 acres of land which was 40 per cent. of his plantation; how many acres did he still own?

Ans. 337½ acres.

THE BASIS AND PERCENTAGE GIVEN TO FIND THE RATE PER CENT.

LXVIII. Ex. A. receives $300 from a capital of $1200; what is the rate per cent.?

Analysis. Now, since $1200 produces $300, it follows that $1 will produce one 1200th part of 300; thus, 300÷1200=$\frac{300}{1200}$=$\frac{1}{4}$=25 per cent.; hence we have the following

Rule III.—*Divide the percentage by the basis, and the quotient reduced to a decimal will be the rate per cent.*

Ex. If the basis be 225, and the percentage 45; what is the rate per cent.?

Operation, 45÷225=$\frac{45}{225}$=$\frac{1}{5}$=20 per cent.

2. A farmer owned 525 acres of land, he sold 320 acres; what per cent of the whole does he still own?

Ans. 39$\frac{1}{21}$ per cent.

3. John bought a knife for .75, sold it and made 15 cts. by the trade; what per cent. did he make?

Ans. 20 per cent.

BASIS AND RATE PER CENT. GIVEN TO FIND THE AMOUNT.

LXIX. Ex. If I pay $5 for a yard of broad cloth; what must I sell it for to make 20 per cent.?

Analysis. Since multiplying the basis by the rate per ct., will produce the percentage, and multiplying any number by a unit, the product will be equal to that number; it follows that, if we multiply the basis by the rate per cent. + a unit (1), the product will be the amount; thus, 20 per cent. $=\frac{1}{5}$ of a dollar $+1=\frac{6}{5}\times\$5=\$6$, the amount, hence we have the following.

Rule IV.—Multiply the basis by the rate per cent. + 1, *the product will be the amount.*

Ex. If I buy calico at .10 per yard, what must I sell it for per yard to make 25 per cent.?

Solution. $(\frac{1}{4}+1)=\frac{5}{4}\times10=\frac{5}{40}=12\frac{1}{2}$ cents, the amount.

Note.—The operation may be performed decimally with the same result, by using 100 instead of 1.

Thus, $.25+100=1.25\times10=.125=.12\frac{1}{2}$ cents.

THE BASIS AND RATE PER CENT. GIVEN TO FIND THE DIFFERENCE.

LXX. *Note.*—The operation is performed precisely as in article LXIX, except the rate per cent. *subtracted* instead of *added;* hence we have the following,

Rule V.—Multiply the basis by 1 *minus the rate per cent., and the product will be the difference.*

Ex. If I pay $5 for an article; what must I sell it for, losing 20 per cent.?

Solution. $1=\frac{5}{5}-\frac{1}{5}=\frac{4}{5}\times\$5=\$4$.

Rem. It will be easily perceived that $\frac{1}{5}$ bears the same relation to 1, that 20 does to 100.

2. Bought a horse for $80, but finding his qualities not good, am willing to lose 16⅔ per cent.; for what must I sell him?

3. Ans. $66.66⅔ cents.

3. Bought broad cloth for $3 per yard; finding it to be damaged, I am willing to lose 12½ per cent.; the selling price required?

Ans. $2.62½.

KNOWING THE AMOUNT AND RATE PER CENT. TO FIND THE BASIS.

LXXI. *Note.*—Now since the amount consists of the basis + the percentage, it follows that the basis must consist of the amount minus the percentage of the basis, consequently, if we divide the amount by the rate per cent. + a unit (1), the quotient will be the basis; hence we have the following.

Rule VI.—Divide the amount by 1 + *the rate per cent. or decimally by* 100 + *the rate per cent., and the quotient will be the basis.*

Ex. If I sell a cow for $32, and make 33⅓ per cent.; what did she cost me? Ans. $24.

Operation, $32÷$\frac{4}{3}$=24 dollars.

Rem. It will be observed that rule VI, is the converse of rule IV, and that they mutually prove each other.

2. Having paid 24 dollars for a cow, what must I sell her for to make $33\frac{1}{3}$ per cent.? Ans. $32.

3. Having paid 377 dollars for house rent, it being 16 per cent. more than I paid last year; required the rent for last year! Ans. 325 dollars.

4. If a merchant sell calico at $12\frac{1}{2}$ cents per yard, and makes $12\frac{1}{2}$ per cent.; what did it cost per yard? Ans. $11\frac{1}{2}$ cents.

DIFFERENCE AND RATE PER CENT. GIVEN TO FIND THE BASIS.

LXXII. *Note.*—The difference, as we have seen, consists of the basis—the percentage; it follows, therefore, that the basis must consist of the difference, plus the percentage of the basis; hence we have the following.

Rule VII.—Divide the difference by the unit (1)*—the rate; the quotient will be the basis.*

Ex. If a merchant sell molasses at $37\frac{1}{2}$ cents per gallon, losing $6\frac{1}{4}$ per cent.; required the cost per gallon? Ans. 40 cents.

Operation, $37\frac{1}{2} \div 1 - \frac{1}{16} = 40$ cents.

Proof, $40 - 37\frac{1}{2} = 2\frac{1}{2} \div 40 = \frac{1}{16}$ of a dollar $= 6\frac{1}{4}$ cents.

Rem. Rule VII is the converse of rule V, and may be proved by it.

2. Sold a horse for $80 per cent., and lost $8\frac{1}{3}$ per cent.; required the cost? Ans. $\$87.27\frac{3}{11}$.

THE BASIS AND RESULTANT NUMBER GIVEN TO FIND THE RATE PER CENT.

LXXIII. Ex. If I pay $75 for a horse, and sell him for 100; what per cent. do I make?

Analysis. Now since I sold the horse for $100 for which

I paid $75, it follows that 100—75=25 the sum made; now since I made $25 on $75. I can only make one 75th of 25 on one dollar; thus 25÷75=$\frac{25}{71}$=$\frac{1}{3}$=33$\frac{1}{3}$ per cent.; hence we have.

Rule VIII.—Divide the difference between the basis and the resultant number by the basis, and the quotient reduced to a decimal will be the rate per cent.

Ex. If I pay $100 for a horse, and sell him for $75; what per cent. do I lose? Ans. 25 per cent.

Operation, 100—75=25÷100=$\frac{25}{100}$=$\frac{1}{4}$=25 per cent.

EXAMPLES FOR SOLUTION.

LXXIV. If I pay 11 cents per yard for calico, and sell it for 12$\frac{1}{2}$ cents per yard; what per cent do I make? Ans. 13$\frac{7}{11}$ per cent.

2. Bought sheeting at 14 cents per yard, and sold it at 16$\frac{2}{3}$; required the rate per cent.? Ans. 19$\frac{1}{2}$ per cent.

Proof by rules IV and V.

Ex. 1. If I sell cloth at 25 cents per yard, which cost 30 cents; what per cent. do I lose? Ans. 16$\frac{2}{3}$ per cent.

2. Bought cotton for 20 cents per pound, sold it for 22$\frac{1}{2}$ cents; what per cent. did I make? Ans. 12$\frac{1}{2}$ per cent.

3. A boy bought an orange for 5 cents, and sold it for 6$\frac{1}{4}$ cents; what per cent. did he make? Ans. 25 per cent.

TO FIND WHAT PER CENT. A GIVEN NUMBER IS OF ANOTHER GIVEN NUMBER.

LXXV. Ex. What per cent. is 2 of 5?

Analysis. The number proposed as the per cent. of another sustains the relation to that number as the percentage to the basis; thus, 2÷5=$\frac{2}{5}$=40 per cent. (See rule III.)

PROBLEMS.

1. What per cent. is 9 of 27? Ans. $33\frac{1}{3}$ per cent.
2. What per cent. is $\frac{1}{4}$ of $\frac{2}{5}$? Ans. $62\frac{1}{2}$ per cent.

FORMULAS OF PERCENTAGE.

LXXVI. 1. *The percentage = the basis × the rate.*
2. *The basis = to the percentage ÷ the rate.*
3. *The rate = percentage ÷ base.*
4. *The amount = the basis × a unit* (1) *+ the rate.*
5. *The difference = the basis × a unit* (1) *— the rate.*
6. *The basis = the amount ÷ a unit + the rate.*
7. *The basis = difference ÷ a unit* (1) *— the rate.*
8. *The rate per cent. =the difference between the base and resultant number ÷ the base.*

MISCELLANEOUS EXAMPLES.

1. In a certain battle, 78 men were killed, which was $13\frac{1}{3}$ per cent. of all engaged; required the number engaged? Ans. 585 men.

2. If I sell $\frac{4}{7}$ of an article for as much as I paid for $\frac{3}{5}$ of it; what per cent. did I make? Ans. $14\frac{2}{7}$ per cent.

RATE PER CENT. ABOVE 100.

LXXVII. *Note.*—The basis being the standard of comparison is neither more not less than 100 per cent.

Now since multiplying by a unit (1) the product is equal to the multiplicand; then, if we multiply the basis by (1), the product will be equal to 100 per cent., and, if by 2 the product will be 200 per cent; hence we have the following.

THE BASIS AND RATE PER CENT. GIVEN TO FIND PERCENTAGE.

Rule I.— Add a unit for every additional hundred, and multiply the basis by the amount, and the product will be the percentage.

Ex. Find the percentage of $25 at 200 per cent.

Operation, $25×2=$50, the percentage.

Note —If the per cent is more than 100 and less than 200, or more than 200 and less than 300, reduce the part of a 100 to a fraction, and add it to a unit or units as the case may be, and multiply as before.

Ex. What is the percentage of $25 at 150 per cent?

Operation, 50=½+1=1½×$25=$37½.

THE BASIS AND RATE PER CENT. BEING GIVEN TO FIND THE AMOUNT.

LXXVIII. Ex. If I pay $15 for an article, what must I sell it for to make 200 per cent.?

Analysis. Now since multiplying the basis by 1, the product will be the basis and, if we multiply the basis by 2 the product will be the per centage; consequently, if we multiply by 1+2=3, the product must be the amount; thus, $15×$3=$45, the amount; hence we have.

Rule II.—Add a unit for each hundred, and multiply the basis by the sum thus found, and the product will be the amount.

Ex. If I pay $32 for an article; what must I sell it for, to make 300 per cent ?

Operation, 1+3=4×32=$128, the amount.

THE AMOUNT AND RATE PER CENT. GIVEN TO FIND THE BASIS.

LXXIX. Ex. If I sell a horse for $125, and make 100 per cent., what did he cost me?

Analysis. As the amount consists of the basis + the percentage; it follows that, if we divide the amount by a unit, + a unit, the quotient must be the basis; thus, 1+1=2; $125÷2=$62.50; hence we have.

Rule III.—Divide the amount by a unit + a unit or fractions of units representing the rate per cent., and the quotient will be the basis.

Ex. If I sell an article for $250, and make 125 per cent; what did it cost me? Ans. 111\frac{1}{9}$.

2. What is the percentage on $\frac{1}{2}$ of a dollar, at 200 per cent.? Ans. $1.

3. What is the amount of $\$\frac{1}{4}$, at 175 per cent.? Ans. $\$\frac{11}{16}$.

4. If I sell an article for $\frac{4}{5}$ of a dollar, and make 115$\frac{2}{3}$ per cent.; what did it cost me? Ans. $\frac{24}{65}$.

Note.—When there is a loss, percentage never can exceed 100 per cent.; since it is impossible to lose more than all; but, when there is a gain, it may exceed 100; because more than 100 per cent. can be made on a 100 (the basis being regarded as 100 per cent.,) it may be doubled, trebled, and quadrupled, &c.

Rem. Percentage has a very extensive application in mercantile transactions, and also in the ordinary business of life.

PARTNERSHIP OR COMPANY BUSINESS.

LXXX. 1. Partnership is as an association of two or more in business with an agreement to share the profits or losses, proportionate to each one's share or stock.

2. The persons thus united are called partners.

3. The money, property or labor invested in trade is called *capital* or *stock*, and the amount which each one contributes is called his *share*.

4. *Profit* is the increase of capital between two given dates.

5. *Loss* is the decrease of capital between two given dates.

6. The amount apportioned to each partner is called *dividend.*

7. The *assets* of a firm are its cash on hand, property and all debts due to it.

8. The *liabilities* of a firm embrace all the debts which it owes, and all its endorsements.

9. The firm is *solvent* when its assets exceed its liabilities, and *insolvent* when its liabilities exceed the cash value of its assets.

10. When the capital is employed for an equal length of time or when no time is specified, it is sometimes called simple partnership; but, when the periods of time are unequal, it is generally called compound partnership.

Note.—It will readily be perceived that the *capital* or *stock* corresponds to the basis in percentage, and the *gain* or *loss* to percentage, and that each partner's share is a partial basis; hence we have the following.

Rule I.—Divide the gain or loss by the capital, and multiply each partner's share by the quotient, and the product will be each partner's share of the gain or loss, respectively. (See rules I and III in per centage.)

Ex. A and B entered into partnership: A contributed $180 and B, $140; they gained $80. What is the gain of each?

Operation, $180+$140=320. $80÷320=$\frac{80}{320}=\frac{1}{4}$.

Again, $180\times\frac{1}{4}=45$, A's share; $140\times\frac{1}{4}=35$, B's share.

Proof, 45+35=80.

Note.—It will be observed that the loss or gain divided by the capital is the rate per cent.; consequently, by mul-

tiplying each partner's capital, the product will be the percentage respectively, and that the sum of these several products, is equal to the given gain or loss, if correct, and that this result is the proof of every operation.

Note 2.—The same result will follow, if we find each partner's fractional part of making such share the numerator of the fraction, and the entire capital the denominator, and multiply each one's part by the gain or loss.

Ex. A, B and C entered into partnership. A contributed \$200, B, \$300 and C, \$400. By the operation, they made \$150. Required each one's share of the gain?

Operation, 200+300+400=900, the entire capital. 200÷900=$\frac{2}{9}$, A's part at the capital. 300÷900=B's part. 400÷900=$\frac{4}{9}$=C's part. Again $\frac{2}{9}\times150=33\frac{1}{3}$, A's share. $\frac{1}{3}\times150=50$, B's share. $\frac{4}{9}\times150=66\frac{2}{3}$, C's share. Proof, $33\frac{1}{3}+50+66\frac{2}{3}=150$.

PARTNERSHIP WITH UNEQUAL TIME.

LXXXI. *Note.*—When capital is invested for different periods of time, the gain or loss is not only proportionate to the amount of capital contributed; but, also to the time it is continued in trade; hence, to find each partner's gain or loss, we have the following.

Rule II.—Multiply each partner's capital by the time it is continued in trade, and then proceed as in rule I.

Ex. A and B formed partnership: A put in \$80 for 3 months, and B, \$40 for 5 months. By the operation they lost \$50. Required the loss of account?

Operation, 80×3=240; 40×5=200; 240+200=440, entire capital. 50÷440=$\frac{5}{44}\times240=27\frac{3}{11}$, A's share, $\frac{5}{44}\times200=22\frac{8}{11}$. Proof, $27\frac{3}{11}+22\frac{8}{11}=50$.

PROBLEMS.

1. A and B agree to raise a cotton crop jointly, which they are to divide as follows: B is to take $1\frac{1}{4}$ lbs. as often as A takes $1\frac{1}{4}$ lbs.; what part of the crop should each one claim, suppose they raise 7,000 lbs., what will be the share of each? Ans. A's part $\frac{3}{7}$; B's, $\frac{4}{7}$; A, share of crop, 3,000 lbs. B's, 4,000 lbs. As the solution of problems like the above is somewhat peculiar, a brief explanation is perhaps needed. The sum of the two parts, viz: $1\frac{1}{4}+1\frac{2}{3}=\frac{35}{12}$, is to be regarded as the basis, but each part taken separately is the percentage, and the quotient of each part divided by the sum of the parts as the rate per cent. Thus $1\frac{1}{4}+1\frac{2}{3}=\frac{35}{12}$; $1\frac{1}{4}\div\frac{35}{12}=\frac{3}{7}$ A's; $\frac{7}{7}-\frac{3}{7}$A's$=\frac{4}{7}$ B's part.

2. C and D together raised a tobacco crop=4,200; they agreed to divide it as follows, every time C took $\frac{5}{6}$ of a pound, D took $1\frac{1}{4}$ pounds. What is each one's part, and what share of the crop should each one claim? Ans. C's $\frac{2}{5}$, D's $\frac{3}{5}$, C's 1,680 pounds, D's 2,520 lbs.

3. One of the stockholders of a rail road company owns 18 shares of $50 each; the dividend is declared to be $7\frac{1}{2}$ per cent. premium; what ought he to receive? Ans. $67.50.

BANKRUPTCY OR INSOLVENCY.

LXXXII. Bankruptcy refers to business failure, and inability to meet pecuniary liabilities.

2. A bankrupt is one who fails or becomes unable to pay his debts.

3. An assignee is a person selected to take charge of the

property, and effects of a bankrupt, to convert the same into cash, and after deducting the necessary expenses of settling, to divide the net proceeds as the law requires among the creditors.

Note.—The net proceeds of a bankrupt estate, is the difference between the available assets, and the necessary expenses of settling the estate; hence, for the solution of problems in bankruptcy we have the following.

Rule.—Divide the net proceeds by the amount of indebtedness, and the quotient will be the rate per cent. on each dollar; then each man's claim being multiplied by the rate per cent., will yield each dividend respectively.

Ex. A, B & Co. have failed. Their indebtedness, $2,000; their assets at cash value $1,500; the expenses of settling, $500; what can they pay on the dollar; and what will D receive whose claim is 700 dollars? Ans. 50 per cent. D will receive $350.

Operation, 1,500—500=1,000÷2,000=$\frac{1}{2}$=50 per cent. $700×50 per cent.=350, D's dividend.

2. C, S & Co. having failed in business, their liabilities are $63,500; their assets have a cash value $52,384; the expenses of settling $1,584, how much can they pay on the dollar, and what dividend should J. D. receive whose claim is $8,361.55. Ans. 80 per cent. J. D. received $6,689.24.

ASSESSING TAXES.

LXXXIII. A tax is a sum of money assessed by the government on individuals, corporations, societies, districts, &c.

2. Taxes for government purposes are imposed on property and in most states on persons.

3. The tax imposed on persons is called poll or capitation tax.

4. Immovable property, such as lands, houses, mills, &c., is real estate.

5. All movable property of whatever kind is called personal property.

6. In assessing taxes, the first thing to be done is, to take an inventory of all taxable property together with a complete list of all the polls.

7. The amount of taxes, assessed on any state, town or corporation, diminished by the capitation tax, is the percentage of all the taxable property; consequently, the value of the taxable property is the basis, and the quotient of the percentage, divided by the basis is the rate per cent.; then the value of each man's property multiplied by the rate, + his poll tax, if any, will be his tax; hence we have the following

Rule.—Subtract the poll tax from the amount to be raised, divide the remainder by the amount of taxable property by the rate per cent., thus found, to which add his poll tax, if any, and the result will be the tax sought.

Ex. A tax of six hundred dollars, is to be levied on a certain town whose taxable property is valued at $100,000; there being 80 polls at $1.25 per poll; required A's tax, who owns $800 worth of taxable property, and pays one poll.

Operation, 80×$1.25=$100; $600—100=$500÷$100,000 =.005 (5 mills). 800×5 mi.=$4+1.25=$5.25 A's tax.

2. A certain town is to be taxed $4,280; the property on which the tax is to be levied, is valued at $1,000,000; there are 200 polls each taxed $1.40; the property of B, is valued at $2,800, and he pays 4 polls; what will be the tax on each dollar, and what will be B's tax? Ans. 4 mills on the dollar; B's tax, $16.80.

Note.—These and similar operations may be proved by subtracting the capitation tax, if any, from the tax of any individual; divide the tax thus found by the number representing the value of his taxable property which will give the per cent. on the dollar—by this per cent. multiply the number representing all the taxable property, and the product will be equal to the amount to be raised on the taxable property of any given town, corporation, or state.

Note 2.—When a tax is levied on personal property, it must be added to that levied on real estate.

COMMISSION, BROKERAGE AND STOCKS.

LXXXIV. Operations, in commission and brokerage, are substantially the same; the only difference is the former is on a larger scale than the latter, and as rules have already been given in percentage which apply to every case, they need not be repeated here.

COMMISSION.

LXXXV. *Commission* is an allowance made to an agent for the purchase or sale or care of property.

2. This agent is called a *factor* or *correspondent* or *commission merchant.*

3. Commissions are estimated at so much per cent. on the money employed.

4. The goods sent, are called a *consignment*, the person who sends them a *consignor*, and the person to whom they are sent, is sometimes called a *consignee.*

Note.—Since the rate per cent. is not fixed by law, it varies very much in different places; but that charged on real estate is generally much less than that on goods.

BROKERAGE.

LXXXVI. *Brokerage* is merely the commission paid to a broker or dealer in stocks, money or bills of exchange for transacting business.

STOCKS.

LXXXVII. *Stocks* are government funds, stock bonds, the capital of banks, insurance, railroad, and manufacturing companies, &c.

2. This *capital* or *money* paid in, is divided into shares which are owned by stockholders.

3. The *original cost* of a share is its *par value.*

4. If it sell in the market for more than its original cost, it is said to be *above par* or at an *advance;* if it sell for less, it is *below par* or at a *discount.*

5. The original cost of a share is usually 100 dollars, though it is sometimes $25, $50, $500, &c.

6. The rise or fall in stocks is a per cent. on the par value. Thus a share whose par value is $\frac{100}{100}$ at 16 per cent. advance, will bring $\frac{116}{100}$ of its original cost; at 16 per cent. discount, will bring $\frac{84}{100}$ of its original cost.

7. The profits of these companies are every year or every half year, divided among the stockholders.

8. The amount so paid out is called a dividend.

MISCELLANEOUS EXAMPLES.

LXXXVIII. An agent having sold $6,000 worth of goods, his commission being $8\frac{1}{3}$ per cent.; what amount must he remit to his consignor? Ans. $5,500.

2. If a commission merchant sell $6,000 worth of goods at 8⅓ per cent.; how much ought he to receive for the sale? Ans. $500.

3. A consignee has received $500 for the sale of goods, his commission being 8⅓ per cent.; what amount of goods did he sell? Ans. $6,000.

4. A factor sells 60 bales of cotton at $425 per bale, and is to receive 2½ per cent. commission; how much must he pay over to his principal? Ans. 24,862.50.

5. I collect for A $268.40, and have 5 per cent. commission; how much do I pay over? Ans. $254.98.

6. G sends $28,638.50, to his broker, to be invested in bank stocks which are 12½ per cent. above par, for which his broker is to receive ¼ of 1 per cent. commission; how many shares of $127 can he pay? Ans. 200 shares.

Solution. $12\frac{1}{2}+\frac{1}{4}=12\frac{3}{4}+100=112\frac{3}{4}$; $\$28,638.50\div 112\frac{3}{4}=25,400\div 127=200$ shares.

INSURANCE.

LXXXIX. *Insurance* is a contract by which an individual or company binds themselves to make good any loss, damage of property by fire or storms at sea or other casualties.

2. Ships and their cargoes, houses, furniture, cattle, &c., are insured.

3. *Life insurance* is a guaranty for the payment of a certain sum of money on the death of the insured.

4. *Health insurance* secures a weekly allowance during the sickness of the insured.

5. This assurance is affected in consideration of a sum of

money, called a premium, which is paid before hand, to the insurers or underwriters.

6. This written agreement of indemnity, is called a policy.

7. The premium is estimated at a certain rate per cent. on the amount insured.

Ex. Mr. Russell paid $2,800 for his house and its insurance; insurance being 5 per cent.; what did the house itself cost him and what did he pay for the insurance? Ans. $2,666.66⅔ cost of house. $133.33⅓ insurance.

Solution. 5 per cent.$=\frac{1}{20}+\frac{20}{20}=\frac{21}{20}$; $2,800$\div\frac{21}{20}$=$2,666.66⅔; $2,800—2,666.66⅔=$133.33⅓.

2. A insured his house and stock of goods at $5,000; the rate being 3 per cent.; required the insurance money? Ans. $150.

3. An insurance of $12,000 was affected on a ship at sea at a premium of 2 per cent.; what did the premium amount to?

PROFIT AND LOSS.

XC. The process of estimating the gains and losses in trade is called *profit* and *loss*.

2. The gain or loss in trade is either the increase or decrease of the basis; since calculations generally proceed from it.

3. Now since the cost of an article is the basis, and the gain or loss the percentage, it follows that the rules which have already been given in percentage, apply equally well to all operations in profit and loss, it therefore supercedes the necessity of their repetition here. (See rules 4 and 5, 9 and 7.)

A grocer purchased a quantity of molasses for which he paid 32 cents per gallon; what must he sell it for per gallon to make 33⅓ per cent.? Ans. 42⅔.

A merchant bought a quantity of broad cloth at $4 per yard, but finding it some what damaged, he is willing to lose 8⅓ per cent.; the selling price required? Ans. $3.33⅓.

EXCHANGE.

XCI. Exchange is the method of transmitting money from one place to another by means of bills of exchange.

Note.—When the places designated are in different countries, it is called *foreign exchange;* but if they are in the same country, it is called *domestic* or *inland exchange.* The limits of this work will not allow us to do more than to state a few plain facts involved in the latter.

2. Bills of exchange also called *drafts* or *checks,* are written orders for the payment of money.

3. A *sight bill* is one payable at sight.

4. A *time bill* is payable at a specified time after sight or date.

5. The *signer* of the bill is the *maker* or *drawer.*

6. The one to whom the draft is addressed, and who is requested to pay it, is the *drawee.*

7. The one to whom the money is ordered to be paid is the *payee.*

8. The one who has possession of the draft is called the *owner* or *holder.* When he sells it, and becomes an *endorser,* he is liable for payment.

9. A special endorsement is an order to pay the draft, to a particular person named, who is called *endorsee,* and no one but the endorsee can collect the bill. When the

endorsement is a blank, the payee merely writes his name on the back, and any one who has lawful possession of the draft can collect it.

10. If the drawee promises to pay at maturity, he writes across the face the word *accepted*, with the date, and signs his name; thus: "Accepted February 10th, 1873. H. Hinton."

11. The *acceptor* is first responsible for payment, and the draft is called an acceptance.

12. A bill of exchange, like a promissory note, may be payable to *order* or *bearer*, and it is subject to protest in case the payment or acceptance is refused. It is generally subject to 3 days of grace, whether a sight or time bill.

THE FORM OF AN INLAND DRAFT.

XCII. $1500. RALEIGH, Feb. 10, 1873.

Please pay at sight W. and D., or bearer, fifteen hundred dollars, value received, and charged.

To K. and C., Brokers in ——. T. A.

Note.—The face of the bill being regarded as the basis or standard of comparison, the exchange will be at par, a premium, or discount; hence we have the following general rule:

Represent the face of the bill at 100 *per cent., and then proceed according to rules already given in percentage, as the nature of the case may require.*

BARTER.

XCIII. *Barter* is an exchange of commodities—such, for instance, as exchanging grain, butter, eggs, chickens, and other agricultural products, for dry-goods, groceries, &c.

GENERAL RULE OF OPERATION.

XCIV. *Find the amount of the commodity to be exchanged, at the given price, and then divide the amount by a number representing the price of a concrete unit of the commodity to be exchanged, and the quotient will be the number of yards, pounds, gallons, &c., sought.*

Ex. How many yards of calico at 14 cents per yard should a lady receive for 22 pounds of butter at 20 cents per pound. Ans. $31\frac{3}{7}$.

Operation, $22 \times .20 = 4.40 \div 14 = 37\frac{3}{7}$.

Proof. Estimate the number of yards thus found by the given price, and the result will be equal to the former; thus, $31\frac{3}{7}$ yards at 14 cents per yard = \$4.40.

2. How many gallons of molasses at 40 cents per gallon should a farmer receive in exchange for 32 bushels of oats at $62\frac{1}{2}$ cents per bushels? Ans. 50 gallons.

3. How many yards of cassimere at \$1.30 per yard should be given in exchange for 9 bushels wheat at \$2 per bushel? Ans. 13 yds. 3 qrs. $1\frac{7}{13}$ na.

4. How many pounds of sugar at 15 cents per pound should I receive for 12 dozen of eggs at 18 cents per dozen?

5. How many yards of broadcloth at \$4 per yard ought I to receive in exchange for 24 bushels of rye at 80 cents per bushel?

6. How many yards of sheeting should be given in exchange for 25 pounds of feathers at 45 cents for pound?

Note.—Questions which have no answers annexed, should be proved.

CUSTOM HOUSE BUSINESS.

XCV. Duties or customs are the toll, tribute, tariff or taxes payable upon merchandise exported and imported.

2. These duties or customs, established by Congress and collected by custom-house officers at various ports of entry, constitute a part of the revenue of a country.

3. Duties are either *specific* or *ad valorem.*

4. A *specific* duty is a fixed sum on a ton, hundred weight, hogshead, gallon, yard, &c., without regard to the value of the commodity.

5. An *ad valorem* duty is a percentage on the cost of the article in the country from which it is imported.

6. *Gross weight* is the entire weight of merchandise with the cask, barrel, bag, &c., containing it.

7. *Net weight* is the weight of the merchandise after all deductions.

8. *Duties* are computed on the net weight.

9. *Draft* is an allowance for waste.

10. *Tare* is an allowance for the weight of cask, box, &c., deducted after the draft.

11. Leakage and breakage are an allowance of 2 per cent. for the waste of liquors in casks, paying duty by the gallon; of 10 per cent. on beer, ale and porter in bottles, and 5 per cent. on all other liquors in bottles. The following is the allowance for draft:

On	112 lbs.	it is	1 lb.
From	112 to 224 lbs.	"	2 lbs.
"	224 to 336 "	"	3 "
"	336 to 1120 "	"	4 "
"	1120 to 2016 "	"	7 "
Above	2016 "	"	9 "

Consequently 9 lbs. is the greatest draft allowed.

Note.—Though not mentioned in a question, *draft* or *leakage* must be deducted before the other specific allowance is made.

Note 2.—In estimating *ad valorem* duties, no deductions of any kind are made where there is actual tare, or actual leakage or waste.

Note 3.—Tare is of three kinds, viz: *legal* tare, or such as is established by law; *customary*, is that which is agreed upon among merchants; *actual* tare, or such as is found by actually weighing the boxes, bags, &c., that contain the goods.

Note 4.—Questions in custom-house business, are solved by rules already given in percentage.

Ex. What will be the duty on 225 bags of coffee, each weighing gross 160 lbs., invoiced* at 6 cents per lb., 2 per cent. being the legal rate of tare, 20 per cent. the duty? Ans. $418,068.

Operation, 160 pounds—2 lbs.=158×225, number of bags, 35,550×6 cts.=2,133.00×2 per ct.=$42.66; 2,133.00—42.66=$2,090.34×20 per ct. $418,068.

2. At 40 per cent. *ad valorem*, what will be the duty on 346 pounds of sewing silk, bought at Florence at $2.50 per pound, Ans. $346.00.

3. What is the duty on 150 bags of coffee, each weighing 158 pounds, invoiced at 7 cents per pound, the tare being 4 per cent. and duty 20 per cent.?

4. What is the duty on 45 casks of wine, of 36 gallons each, invoiced at $1.25 per gallon, at 40 per cent. *ad valorem?*

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* An invoice is a schedule of the articles imported, together with the cost.

PERCENTAGE INVOLVING TIME.

XCVI. Percentage involving time embraces interest simple and compound, true discount, bank discount, and equation of payments.

SIMPLE INTEREST.

XCVII. *Terms—Principal, Rate per cent. Interest, Time and Amount.*

Rem.—Any three of these being given, the fourth may be found.

Definitions.—Interest is a charge made for the use of money.

2. The *principal* is the sum on which the interest is computed, and corresponds to the *basis* in percentage without time.

3. The *rate per cent.* expresses what a dollar draws in one year.

4. The *interest* is the percentage expressing the aggregate amount of the several parts of dollars contained in the principal as indicated by the rate per cent.

5. The *time* expresses how long the principal has to run.

6. The *amount* consists of the principal, plus the interest.

PRINCIPAL, RATE PER CENT., AND TIME GIVEN TO FIND THE INTEREST.

XCVIII. Ex. What is the interest of $5, at 6 per cent., having 8 months to run? Ans. 20 cents.

Analysis. Now, since the rate per cent. is the interest of $1 or 100 cents for one year or 12 months, it follows

that the rate per cent. divided by 12, will express what a dollar draws in one month; thus, $\$6 \div 12 = \frac{6}{12} = \frac{1}{2}$. Again, since a dollar draws $\frac{1}{2}$ cent in one month, 5 dollars must draw 5 times $\frac{1}{2}$; thus, $\frac{1}{2} \times 5 = \frac{5}{2}$. Again, since 5 dollars draw in one month, it follows that it will draw 8 times that in 8 months; thus, $\frac{5}{2} \times 8 = \frac{40}{2} = 20$ cents, the interest; or it may be briefly stated as follows: $\frac{1}{2} \times \frac{5}{2} = \frac{5}{2} = \frac{40}{2} = 20$ cents.

REM.—From the preceding analysis, a rule may be formed which will apply to every case in which the interest is sought, except when time is expressed in days only; hence we have the following

RULE.—*Multiply the interest of one dollar for one month by the principal, which will be the interest for one month; then multiply this interest by the given time in months, and the product will be the interest sought.*

What is the interest of $24.64 at 8 per cent., having 9 months to run? Ans. $1.4784.

Operation, $\frac{8}{12} \times 24.64 = 16.42\frac{2}{3} \times 9 = \$1.4784$. This and similar operations may be proved by dividing the interest by the time, and multiplying the quotient by 12, and dividing by the rate per cent.; thus, $\$1.4784 \times 9 = 16.42\frac{2}{3} \times 12 = \$1.9762 \div 8 = \$24.64$, the proof.

Rem. The reason of this operation will be given hereafter.

2. What is the interest of $20 at 10 per cent. having 1 year and 8 months to run? Ans. $\$3.33\frac{1}{3}$.

Operation. $\frac{5}{6} \div 20 = \frac{100}{6} \times 20$ mo. $= \frac{2000}{6} = \$3.33\frac{1}{3}$.

3. What is the interest of $9 at 6 per cent. having 7 months and 15 days to run? Ans. $33\frac{3}{4}$ cents.

Note.—When days occur, reduce them to the fraction of a month, and proceed as directed in the rule.

Rem. In order to facilitate operations, a table exhibiting what $1 will draw in one month, from 1 to 12 per cent. is given below. The first column represents the rate per cent., the second a common fraction of equal value, and the third fractions in their lowest terms.

Rate.		Common fraction.		Lowest Terms.
1	=	$\frac{1}{12}$	=	$\frac{1}{12}$
2	"	$\frac{2}{12}$	"	$\frac{1}{6}$
3	"	$\frac{3}{12}$	"	$\frac{1}{4}$
4	"	$\frac{4}{12}$	"	$\frac{1}{3}$
$4\frac{1}{2}$	"	$\frac{9}{24}$	"	$\frac{3}{8}$
5	"	$\frac{5}{12}$	"	$\frac{5}{12}$
6	"	$\frac{6}{12}$	"	$\frac{1}{2}$
$7\frac{1}{2}$	"	$\frac{15}{24}$	"	$\frac{5}{8}$
7	"	$\frac{7}{12}$	"	$\frac{7}{12}$
8	"	$\frac{8}{12}$	"	$\frac{2}{3}$
9	"	$\frac{9}{12}$	"	$\frac{3}{4}$
10	"	$\frac{10}{12}$	"	$\frac{5}{6}$
11	"	$\frac{11}{12}$	"	$\frac{11}{12}$
12	"	$\frac{12}{12}$	"	$\frac{1}{1}=1$

Note.—When the time is expressed in years only, the operations may be sometimes facilitated by multiplying the principal by the rate per cent., which will give the interest

for one year, and this interest multiplied by the number of years, will give the interest sought.

Ex. Required the interest of $35.25 for 3 years, at 7 per cent.? Ans. $7.4025.

Operation, $35.25×7 per cent.=$2.4675×3 per cent.=$7.4025.

EXAMPLES FOR PRACTICE.

XCIX. 1. Find the interest on $24.15 for 10 months at 6 per cent.

2. What is the interest of $2.10, having 30 months and 20 days to run, at 10 per cent?

3. Required the interest of $125 for 6 months and 10 days, at 8 per cent.?

4. What is the interest of $42.35, having 4 years to run, at 6 per cent.?

C. WHEN THE PRINCIPAL CONSISTS OF CENTS ONLY OR CENTS AND MILLS.

The operation may be performed by reducing the cents or cents and mills to the fraction of a dollar; and, proceeding according to the rule already given, or by finding the interest on one cent for one month or one year as the case may be, and multiplying the interest thus found by the time.

Ex. What is the interest of 2 cents, and 5 mills equal to $2\frac{1}{2}$ cents at 6 per cent., having 8 years and 4 months to run?

Solution. Now, since $1 draws $\frac{1}{2}$ a cent in one month, one cent will only draw $\frac{1}{100}$ part of $\frac{1}{2}$; thus $\frac{1}{2} \div 100 = \frac{1}{200}$; if one cent will draw $\frac{1}{200}$, $2\frac{1}{2}$ cents will draw $2\frac{1}{2}$ times that; $\frac{1}{200} \times 2\frac{1}{2} = \frac{5}{400} = \frac{1}{80}$, and, if $2\frac{1}{2}$ cents draw one $\frac{1}{80}$ in month, it will

draw 100 times that in 100 months; $\frac{1}{80}\times 100=\frac{100}{80}=\frac{10}{8}=1\frac{1}{4}$ cts., answer.

Briefly, thus, $\frac{1}{2}\div 100\times 2\frac{1}{2}=\frac{5}{400}=\frac{1}{80}\times 8$ years and 4 months$=\frac{100}{80}=1\frac{1}{4}$ cents.

CI. When the time is expressed in days only.

Rem. In computing interest, business men generally assume 12 calendar months for a year, and 30 days for a month; but, as there are 7 months which have 31 days each, and 4 months which have 30 days and one having but 28, the interest will generally be a little too small, and possibly sometimes a little too large; but the error in any case will be very slight; in consequence, of this, however, some banking corporations express the time of their bonds in days only, and, as we are not allowed, in such cases to assume 30 days for a month, the following method has been devised.

Rule.—Find the interest for one year, and, then divide this interest by 365, *(disregarding the odd hours), and the quotient will be the interest for one day; multiply the quotient by the number of days specified, and the product will be the interest sought.*

Ex. What is the interest of $500 at 6 per cent., having 62 days to run? Ans. $5.095.

Operation. $500\times 6=$30 interest for one year; $30.00\div 365=.08\frac{16}{73}\times 62$ days$=$5.095.

CII. Method of computing interest on English currency.

Note.—As it is sometimes expedient to calculate interest on English currency, and as questions of this kind are generally found in most Arithmetics now in use, a short and accurate method of calculating the interest on this currency, is desirable. Operations of this kind may be performed in a way similar to that which has already been

given, viz: after reducing the given denominations to the fraction of a pound.

Multiply the principal by what one pound will draw in one month, and this product by the number of months, and the result will be the interest sought in shillings.

Ex. Required the interest on £ 30, at 6 per cent. for 5 months.

Operation $\frac{1}{10}$ of a shilling$\times$£ 30$=\frac{30}{10}$=3s.$\times$ 5=15s. interest.

Rem. In the following table will be found what one pound will draw in one month, from 1 to 12 per cent.:

TABLE.

Rate per cent.		Part of a shilling.		Lowest terms.
1	=	$\frac{1}{60}$	=	$\frac{1}{60}$
2	"	$\frac{2}{60}$	"	$\frac{1}{30}$
3	"	$\frac{3}{60}$	"	$\frac{1}{20}$
4	"	$\frac{4}{60}$	"	$\frac{1}{15}$
5	"	$\frac{5}{60}$	"	$\frac{1}{12}$
6	"	$\frac{6}{60}$	"	$\frac{1}{10}$
7	"	$\frac{7}{60}$	"	$\frac{7}{60}$
8	"	$\frac{8}{60}$	"	$\frac{2}{15}$
9	"	$\frac{9}{60}$	"	$\frac{3}{30}$
10	"	$\frac{10}{60}$	"	$\frac{1}{6}$
11	"	$\frac{11}{60}$	"	$\frac{11}{60}$
12		$\frac{12}{60}$	"	$\frac{1}{5}$

Note.—By using the above table, operations in English money will be almost as simple and easy as those in United States currency.

EXAMPLES FOR PRACTICE.

CII. 1. What is the interest on £144 for 6 months and 20 days, at 5 per cent.? Ans. £4.

2. Required the interest on 15s. for 2 years and 6 months, at 6 per cent.? Ans. 2s. 3d.

3. What is the interest on 12s. 6d. for 1 year and 3 months, at 6 per cent.? Ans. 11¼d.

CIII. INTEREST, RATE PER CENT. AND TIME GIVEN TO FIND THE PRINCIPAL.

Ex. 20 cents being the interest, 6 per cent. the rate, 8 months the time; required the principal.

Analysis, $20 \div 8 = 2\frac{1}{2}$ interest for 1 month, $2\frac{1}{2} = \frac{5}{2} \times 12 = 30$ cents, interest for one year; now, since the interest of any given principal, multiplied by the rate per cent., will give the interest for one year, it follows that, if we divide the interest of one year by the rate, the quotient will be the principal; thus, $30 \div 6 = \$5$, the principal. Hence we have the following

Rule.—Divide the given interest by the time in months, multiply the quotient by 12, *divide the product by the rate per cent. and the quotient will be the principal.*

Note—If the time is expressed in years only, multiplying by 12 should be dispensed with.

Note 2.—Operations, under this rule, are proved by casting the interest on the principal, which, if correct will be equal to the given interest.

CIV. THE PRINCIPAL, INTEREST AND RATE PER CENT. GIVEN TO FIND THE TIME.

Ex. Let the principal be \$12, the interest 60 cents, the rate 6 per cent.; required the time.

Analysis. Now, since \$12 has drawn 60 cents, it is evident that \$1 will only draw $\frac{1}{12}$ of 60 cents; thus, $60 \div 12 = 5$; now, since \$1 has drawn 5 cents, and that \$1, at 6 per cent. will draw $\frac{1}{2}$ cent in one mo.; it follows that as often as 5 contains $\frac{1}{2}$, must be the time in months; thus, $5 \div \frac{1}{2} = 10$ months, time sought. Hence we have the following

Rule.—Divide the interest by the principal, and the quotient by what one dollar will draw in one month at the given rate, and the result will be the time in months required.

Ex. The principal being \$40, the interest \$1.60, and the rate 8 per cent. What is the time? Ans. 6 months.

Operation, $\$1.60 \div 40 = 4$ cents; $4 \div \frac{2}{3} = 6$ months.

CV. THE PRINCIPAL, INTEREST AND TIME BEING GIVEN TO FIND THE RATE PER CENT.

Ex. Let \$10 be the principal, 40 cents the interest and the time 8 months.

Analysis. \$1 will draw one-tenth of the interest; hence, $40 \div 10 = 4$ cents; now, since \$1 has drawn 4 cents in 8 mo., it can only draw $\frac{1}{8}$ of 4 in 1 month; thus, $4 \div 8 = \frac{4}{8} = \frac{1}{2}$; now, since $\frac{1}{2}$ expresses what \$1 has drawn in one month, it will draw 12 times $\frac{1}{2}$ in 12 months; thus, $\frac{1}{2} \times 12 = \frac{12}{2} = 6$, the rate. Hence we have the following

Rule.—Divide the interest by the principal and the quotient by the time, and multiply the last quotient by 12, *and the product will be the rate sought.*

Ex. Let the principal be $40, interest $1.60, time 6 mo.; required the rate. Ans. 8 per cent.

Operation, $1.60÷$40=4 cents. 4÷6=$\frac{4}{3}$×12=$\frac{24}{3}$=8 per cent.

Note 1.—It will be observed that this operation proves the example under the next preceding rule.

Note 2.—Most states have established a certain rate per cent. by law; this is called legal or lawful interest.

PARTIAL PAYMENTS.

CVI. *Partial payments* are parts of a note or bond paid at different times, and endorsed upon its back. The principles involved in computing the interest on partial payments, make it convenient to divide the rule adopted by the Supreme Court of the United States, and most of the States into two parts or two rules.

WHEN THE PAYMENT OR PAYMENTS EXCEED THE INTEREST.

CVII. *Rule I.—Compute the interest on the principal, from the date of the note to the date of the first payment, and then from the amount, subtract the payment, and the difference will be the new principal; continue the operation in a similar way, till the time of settlement, and the last amount will be what remains due.*

WHEN THE INTEREST EXCEEDS THE PAYMENT.

CVIII. *Rule.—Compute the interest as before, but pay no attention to the payment, till the second payment is reached, and then if the sum of the payments exceed the interest; from the amount, subtract the amount of the payment, and the difference will constitute a new principal with which proceed as before, till the time of settlement be reached.*

Ex. On a certain note dated January 1st, 1870, whose

face calls for $20, with interest, at 6 per cent., having 12 months to run, were endorsed the following payments: April 1st, 1870, $8. On August 1st, 1870, $5. On the first of November, 1870, $4. What will remain due January 1st, 1871?

Operation, $20×½=10 cts.×3 months=30+$20=$20.30, the amount—$8=$12.30, second principal; $12.30×½=.615×4 months=.246+$12.30=$12.546—$5=$7.546, third principal; $7.546×½=.3773×3 months=$113; 7.543+.113=$7.659—$4.=$3.659, fourth principal; $3.659×½=.01829½×2 months=.036; $3.659+.036=$3.695+, answer.

The following symbolic formulas will perhaps afford some aid in understanding the above rules. Let P symbolize the first principal; the figured P's, the consecutive principals respectively; I, the interest, and A, B, C, D, &c., the several payments.

FORMULAS.

CIX. I. P+I—A=2P; 2P+J—B=3P; 3P×J—C=4P; 4P+J=to the sum due at the time of settlement.

II. P+J—A+B=2P; 2P+J—C+D=3P; 3P+J=to the sum due.

Note 1.—It will often happen in the same operation that both parts of the rule will have to be applied.

Note 2.—The number of letters symbolizing the endorsements on a note, must vary with the number of payments.

Note 3.—In order to insure accuracy in the operations, it would be well to prove each partial operation before forming a new principal.

COMPOUND INTEREST.

CX. Compound interest is the interest computed on the amount; i. e., every successive amount becomes a new principal, and the number of principals thus found, will depend on the number of intervals involved in the time which the note or bond has been on interest.

The length of time which a note has to run before the interest is added, and a new principal formed, will depend on the time stipulated by the parties concerned.

When the interest is added at the end of each year, it is said to compound annually, and when it is added at the end of each half year, it is said to compound semi-annually, etc.

TO FIND COMPOUND INTEREST.

CXI. RULE.—*Find the interest on the principal, as in simple interest; add the interest thus found to the principal; on this amount proceed as before; and from the last amount subtract the given principal, and the difference will be the compoundinterest sought.*

Ex. What is the compound interest on $300 for 3 years at 6 per cent.?

Operation, $300×6=$18.00+$300.00=$318.00, second principal; $318×6=$337.08, third principal; $337.08×6=$20.2248+337.08=$357.3048, amount for 3 years; $357.3048—$300.00=$57.3048, answer.

Note 1.—When partial payments have been made on notes at compound interest, it is customary *to find the amount of the given principal, and from it to subtract the sum of the several amounts of the endorsements.*

Note 2.—Though compound interest is not generally favored by the law, it is not usurious. A contract or promise to pay money with compound interest cannot generally be enforced, being only valid for the principal and legal interest. In this State, however, the money of wards is allowed to draw compound interest.

EXAMPLES.

CXII. 1. What is the amount of $100 at 6 per cent. per annum, compound interest, for ten years, the interest being payable semi-annually? Ans. $112.55.

2. What is the compound interest on $630 for four years at 5 per cent.? Ans. $135,769.

Note.—Operations in compound interest are proved by dividing the amount by the amount of one dollar for the given time and rate, and, if correct, the quotient will be the first principal.

TRUE DISCOUNT.

CXIII. Discount is an allowance made for the payment of money before it becomes due.

There are three things involved in discount, viz: the face of the note, the present worth, and the discount.

The face of the note is the amount specified in the note.

The present worth is what the face of the note is worth at present in cash, and is the difference between the face and its discount.

The discount is the difference between the face of the note and its present worth.

Note.—The simple interest on the face of the note is not its true discount. Simple interest expresses the fractional part of the principal indicated by the rate per cent., the

rate being the numerator, and 100 being the denominator, as $\frac{6}{100}$; but the discount expresses the fractional part of the face of the note, as indicated by the rate per cent.; but the denominator of the fraction is 100+the rate thus, $\frac{6}{106}$.

THE FACE OF THE NOTE, RATE, AND TIME GIVEN TO FIND THE PRESENT WORTH.

CXIV. Ex. What is the present worth of $224, having 2 years to run, at 6 per cent.?

Now, since the present worth expresses the present value of the face of the note, it follows that the face of the note divided by $1, its interest for the given rate and time, must give $1 of present worth for each time it is contained in the face of the note; thus, $224÷($1+12 cts.)=$200.00; hence we have the following

Rule.—Divide the face of the note by the amount of $1 *for the given rate and time, and the quotient will be the present worth.*

Ex. What is the present worth of $327.00, having 1 year and 8 months to run, at 6 per cent.?

Operation, $327.00÷1.09, (the amount on $1)=$300.00 ans.

Note.—The discount is found by subtracting the present worth from the face of the note; thus, as in the example of the above: $327.00 (face of the note,)—$300.00 (present worth)=$27 (discount.)

EXAMPLES FOR PRACTICE.

CXV. What is the *discount* on $75.50 for 2 years, 6 months, at 8 per cent.? Ans. $12.58⅓.

What is the *discount* on $100.00, due 6 months hence, at 6 per cent.? Ans. $2.913.

I bought a bill of goods on 6 months' credit, amounting to $973.50; how much ought to be deducted if cash is paid at the time of receiving the goods, interest being 6 per cent.? Ans. $28.35.

What is the present worth of $940.00, having 6 months to run, at 6 per cent.?

THE PRESENT WORTH, RATE, AND TIME GIVEN TO FIND THE FACE.

CXVI. RULE.—*Compute the interest on the present worth at the given rate and time, add the interest to the present worth, and the amount will be equal to the face of the note.*

Ex. The present worth of a certain note of $200.00, the time 2 years, and the rate 6 per cent.; required, the face of the note. Ans. $224.00.

Operation, $200×6=$12×2 yrs.=$24×$200=$224.00.

Note.—This operation is the proof of the next preceding rule.

BANK DISCOUNT.

CXVII. BANK DISCOUNT differs from *true discount* in this particular: in the former, interest is computed on the face of the note, and in the latter, on the present worth or value.

TO FIND BANK DISCOUNT.

CXVIII. RULE.—*Add* 3 *days, called days of grace, to the time the note has to run, then compute as in simple interest, and the interest thus found will be the discount sought.*

Note.—The difference between the face of the note and the discount is called the *present worth* or *proceeds.*

Ex. Find the bank discount on $150 for six months, at 6 per cent. Ans. $4.575.

Operation, $150×$\frac{1}{2}$=75×6$\frac{1}{10}$ months=$4.575.

2. If I deposit a note of $600 in bank, discounted at 6 per cent., what sum ought I to receive? Ans. $590.70.

3. Find the bank discount of $375 for 3 months and 9 days, at 7 per cent. Ans. $7.438.

4. A note for $1800, payable in 60 days, was discounted at a bank, at 6 per cent., what was received for the note? Ans. $1781.10.

5. What is the bank discount of $300, discounted at 10 per cent.?

TO FIND THE FACE OF A NOTE.

CXIX. RULE.—*Divide the present worth or proceeds by the present worth of one dollar for the given rate and time, and the quotient will be the face of the note.*

Ex. I wish to borrow $590.70, discounted at 6 per cent.: required the face of the note to be deposited. Ans. $600.

Note.—It will readily be perceived that this and the next preceding rule mutually prove each other.

2. If I receive $550, discount being at 10 per cent., what is the face of the note?

EQUATION OF PAYMENTS.

CXX. *Equation of payments* is a process by which we ascertain the average time for payments of several sums, due at different times.

Suppose I owe $1000, of which $100 are due in two months, $250 in four months, $350 in 6 months, and $300 in 9 months. If I pay the whole sum at once, how many months' credit ought I to have?

Analysis. A credit on $100 for 2 months is the same as

a credit on $1 for 200 months; thus, $100×2 months=200 months. A credit on $250 for 4 months is the same as a credit on $1 for a thousand months; thus, $250×4 months =1000 months. A credit on $350 for 6 months is the same as a credit on $1 for 2100 months; thus, $350×6 months =2100 months. A credit on $300 for 9 months is the same as a credit on $1 for 2700 months; thus, $300×9 months =2700 months. $100+$250+$350+=$1000. 200 months +1000 months+2100 months+2700 months=6000 months. Hence I ought to have the same as a credit on $1 for 6000 months; but, if I wish a credit on $1000 instead of $1, it is evidently to be for only $\frac{1}{1000}$ of 6000 months, which is 6 months; hence we have the following

RULE.—*Multiply each payment by the time it has to run, divide the sum of the several products by the sum of the payments, and the quotient will be the equated time.*

Ex. A owes B $160; $80 have two months to run; $50 4 months; $30, 6 months: required, the equated time.

Operation, $80 × 2 months = 160 months.

$50	"	4	"	"	200 "
$30	"	6	"	"	180 "
$160					540 "

Again, 540 months÷160 dollars=$3\frac{3}{8}$ months, answer.

Proof. Compute the interest on the sum of the payments for the equated time, and also on each payment for the time it has to run, and, if correct the sum of the interest of the several payments, will be equal to the interest of the sum of the payments for the equated time, or the interest of $1 for

the entire number of months, will equal each of the others; thus, $160 \times \frac{1}{2} = 80$ cents $\times 3\frac{3}{8}$ months $= \$2.70$

80	"	$\frac{1}{2}$	"	40	"	"	2	"	"	80
50	"	$\frac{1}{2}$	"	25	"	"	4	"	"	1.00
30	"	$\frac{1}{2}$	"	15	"	"	6	"	"	90
										$2.70

Or, $\$1 \times \frac{1}{2} = \frac{1}{2}$ cent $\times$ 540 months $= \$2.70$

TO FIND THE TIME FOR ANY PRINCIPAL AT A GIVEN RATE, TO DOUBLE ITSELF.

CXXI. Now, since the rate per cent. is equal to the number of cents which a dollar will draw in one year, it follows that at one per cent., a dollar will draw but 1 cent in a year, consequently it will require 100 years to draw 100 cents or to double itself.

Now, it is obvious that it will require but $\frac{1}{5}$ of the time for any principal to double itself at 5 per cent., which is required at 1 per cent., and, since it takes 100 years at 1 per cent. to double itself, then. if we divide 100 by 5, the quotient will be the time required for any principal to double itself at 5 per cent.; thus, $100 \div 5 = 20$ years, the time required; hence we have the following

Rule.—Divide 100 *by the rate per cent., and the quotient will be the time required for any principal to double itself.*

Ex. How long will it take a principal to double itself at 6 per cent.? Ans. $16\frac{2}{3}$ years equal to 16 years and 8 months.

MENSURATION.—DEFINITIONS.

CXXII. 1. A *point* has position only.

2. A *line* has length only.

3. A *straight line* is the shortest distance between two given points, as the line A———B.

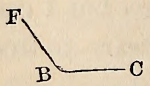
4. A *curved line* changes its direction continually; as, the line C——D.

5. An *angle* is the opening of two lines meeting in a point.

6. A *right angle* is formed by a straight line and one perpendicular to it, as the angle

7. An *acute angle* is one less than a right angle, as the angle

8. An *obtuse angle* is one greater than a right angle; as, angle



Mensuration is divided into two parts, viz: mensuration of surfaces and mensuration of solids or volumes.

MENSURATION OF SURFACES.

CXXIII. A surface has but two dimensions—length and breadth, and is measured by means of a square as the unit of measures.

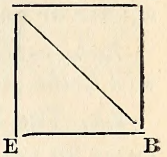
It is applicable to the measurement of every thing in which surface only is concerned.

Every portion of surface may be regarded as bounded either by right lines or by curves.

LAND MEASURE.

CXXIV. The square is the simplest form of geometrical figures; it is bounded by four lines of equal dimension having all its angles, right angles. (See figure 1.)

Fig. 1



TO FIND THE AREA OF A SQUARE, &C.

CXXV. The *area* of the square, and that of all its species called parallelograms, is found by multiplying its two dimensions together or base and perpendicular, and the product will be the area or surface in the same denomination as the given dimensions. (See square measure rule 1.)

Ex. How many acres are there in a piece of ground 20 rods square? Ans. 400 rods=2 acres 2 roods.

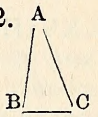
This, and similar operations, may be proved by dividing the area by one of the dimensions, and the quotient will be the other.

2. In a certain piece of ground containing 5 acres, one of its sides is 40 rods long; required the other? Ans. 20 rods.

3. A certain piece of ground is 80 chains long and 30 wide; required the number of acres? Ans. 240 acres.

A *triangle* is a figure bounded by three straight lines. (See figure 2.)

Fig. 2.



TO FIND THE AREA OF A TRIANGLE.

CXXVI. Now, since a triangle is equal to two right angles, it follows that every rectilineal figure must be equal to

two triangles (see figure 1, diagonal D, B); consequently, the area of a triangle can only be half as much as that of a square or parallelogram; hence, we have the following

Rule.—Multiply the altitude by half the base, the product will be the area sought.

Ex. The base of a triangle is 50 yards, and the perpendicular 30 yards; what is the area? Ans. 750 square yards.

Operation, $25 \times 30 = 750$.

2. How many acres are there in a triangular piece of ground whose base is 40 rods, and altitude 35 rods? Ans. 4 acres 1 rood 20 rods.

THE AREA AND ONE OF THE DIMENSIONS GIVEN TO FIND THE OTHER.

CXXVII. *Rule.—Reduce the area to the denomination indicated by the given dimension, and the quotient will be the other.*

Ex. In a certain triangular piece of ground containing 7 acres, whose base is 60 rods; required the altitude? Ans. 37½ rods.

Note.—Any one of the sides of a triangle may be assumed as the base.

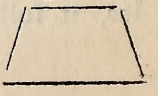
TO FIND THE AREA OF A TRIANGLE WITH THE PERIMETERS OR THREE SIDES GIVEN.

CXXVIII. *Rule.—Take half the sum of the sides, subtract each side from it; multiply the three remainders, and half the sum together; extract the square root of the product; this will be the area in square units.*

Ex. Sides 1 foot 10 inches; 2 feet; 3 feet 2 inches. Ans. 1 square foot, 102 square inches.

A trapezoid is a figure of 4 sides, two of which are parallel, but unequal, and are called the basis. (See figure 3.)

Fig. 3.



TO FIND THE AREA OF A TRAPEZOID.

CXXIX. *Rule.—Take the half the sum of the basis, and multiply it by the altitude after expressing them in the same denomination, and the product will be the area in square units of the same kind.*

Ex. What is the area of a trapezoid whose bases are 45 rods and 35, and altitude 20 rods? Ans. 5 acres.

Operation, $45+35=80\div 2=40\times 20=800\div 160=5$ acres.

TO FIND THE AREA OF ANY IRREGULAR FIGURE BOUNDED BY FOUR STRAIGHT LINES OR MORE.

CXXX. *Rule.—Resolve the area of the figure into triangles, and the sum of the areas of the several triangles, will be the area sought.*

A *circle* is a portion of a plane bounded by a curved line, every point of which is equally distant from a point within called the centre; the curved line A, B, C, D, is called the circumference; the point C, the center; the line A B passing through the center, the diamater, and C B, the radius. See fig. 4.

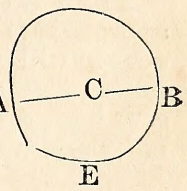


Fig. 4

THE DIAMETER OF A CIRCLE BEING GIVEN TO FIND THE CIRCUMFERENCE.

CXXXI. *Rule I.—Multiply the diameter by* $\frac{7}{22}$, *and the product will be the circumference.*

Ex. What is the circumference of a circle whose diameter is 14? Ans. 44, the circumference.

THE CIRCUMFERENCE BEING GIVEN TO FIND THE DIAMETER.

Rule II.—Multiply the circumference by $\frac{7}{22}$, *and the product will be the diameter.*

Ex. The circumference of a certain circle is 66 feet; required the diameter? Ans. 21, the diameter.

Note.—This rule is the converse of the former, and the two rules mutually prove each other.

THE DIAMETER BEING GIVEN TO FIND THE AREA OF A CIRCLE.

CXXXII. RULE.—*Find the circumference by rule the first; multiply the circumference and diameter together, and divide the product by* 4, *and the quotient will be the area; or multiply the square of the diameter by* $\frac{11}{14}$ *and the product will be the area sought.*

Ex. The diameter of a circular piece of ground is 35 rods: required, the area. Ans. 962½ rods=6 acres, $2\frac{9}{16}$ rods.

Note.—If the above rules are not perfectly accurate, they approximate so near correctness that no error of any consequence will result from their use; nor am I aware that the exact relation of the circumference to the diameter has ever been determined; but one thing is certain, that much labor and time will be saved by their adoption.

FLOORING, CEILING, ROOFING AND CARPETING.

CXXXIII. How many feet of plank, allowing $\frac{1}{10}$ for dressing, will be sufficient to floor and ceil* a room whose dimensions are 30 ft. by 20? Ans. 1333⅓ feet.

Operation, 30×20=600×2=1200 feet, number of square feet in both floors; $\frac{10}{10}-\frac{1}{10}=\frac{9}{10}$; 1200 feet÷$\frac{9}{10}$=1333⅓ feet. Hence when a deduction is to be made for waste in dressing, we have the following

---

* Overhead ceiling is meant.

RULE.—*Find the number of square feet in the floors; subtract the fraction denoting the waste in dressing from a unit, and divide the number of square feet in the floor or floors by the remainder, and the quotient will be the number sought.*

Ex. How many feet of rough plank will be sufficient to floor a room 24×18 feet, allowing $\frac{1}{10}$ for dressing? Ans. 480 feet.

2. How many yards of carpet, three quarters wide, will be sufficient to carpet a floor 24 feet by 18? Ans. 64 yds.

Operation, 24×18=432 square feet; 432÷9=48 square yards; 48÷$\frac{3}{4}$=64 yards.

TO FIND THE NUMBER OF YARDS AT A GIVEN WIDTH TO CARPET A FLOOR OF GIVEN DIMENSIONS.

CXXXIV. RULE.—*Find the number of square yards contained in the floor; divide by the width of the carpet, and the quotient will be the number of yards sought.*

Ex. How many yards of carpet will it take, 5 quarters wide, to carpet a floor 27 feet by 16? Ans. $36\frac{2}{5}$ yards.

2. What must be the length of a room 18 feet wide that 64 yards of carpet, 3 quarters wide, will cover. Ans. 24 feet.

Operation, 64×$\frac{3}{4}$=48×9=432÷18=24, the length of the room.

3. How many yards of paper $\frac{5}{8}$ wide, will paper a room 16 feet by 14, and 7 feet high?

Ans. 127 yards, 3 quarters and $1\frac{17}{45}$ na.

Note.—In roofing or house covering, it is customary to make shingles 4 inches wide, and to show 6 inches; and to make rafters $\frac{2}{3}$ of the width of the house, and both rafters being taken together are equal to $\frac{4}{3}$ of the width of the house.

Ex. How many shingles will it require to cover a house 24 feet by 15? Ans. 2880.

Operation, $15 \times \frac{4}{3} = 20 \times 24 = 480 \div \frac{1}{6} = 2880$. Hence we have the following

RULE.—*Multiply the width by* $\frac{4}{3}$ *and the product by the length of the roof; divide by* $\frac{1}{6}$ *of a foot, and the quotient will be the number of shingles sought.*

Ex. How many shingles will be necessary to cover 40 feet by 24? Ans. 7680.

NOTE.—The same result may be obtained by reducing the number of square feet in the roof to square inches, and dividing by the number of square inches in a shingle; but this would be quite a tedious process.

2. Required, the number of shingles necessary to cover a house 28 feet by 16 ?

PLASTERERS', PAINTERS', PAVERS' AND CARPENTERS' WORK.

CXXXV. This work is computed by the square yard; glaziers work by the square foot or pane; carpenters and joiners work by the square yard—sometimes by the square, which is 10 feet square, and contains 100 square feet.

Ex. What will it cost to roof a house at 40 cents per square yard, 30 feet by 24? Ans. $\$41.86\frac{2}{3}$.

2. What will it cost to plaster the walls of a room 20 feet by 12 and 8 feet high, at 20 cents per square yard, no deductions being made for doors and windows? Ans. $\$11.33\frac{1}{3}$.

3. What will it cost to ceil a room 30 feet by 20, 8 feet high, at \$2 per square? Ans. \$28.00.

4. Find the cost of paving the floor of a court-room 50 feet by 20 feet and 6 inches, at 75 cents per square yard? Ans. $\$85.41\frac{1}{3}$.

BOARD MEASURE.

CXXXVI. Board measure is applied to the measurement of timber or lumber sawed.

TO MEASURE INCH BOARDS AND BOARDS LESS THAN AN INCH IN THICKNESS.

CXXXVII. Regarding inch boards as the standard or unit of comparison, we have the following

RULE.—*Multiply the length and width together, and the product will be the number of square inches or feet sought.*

Ex. Required, the number of square feet in an inch board 12 feet long and 8 inches wide? Ans. 8 feet.

Operation, $12\times8=96$; $96\div12=8$ feet.

Note.—Such operations may be facilitated by reducing the inches or primes to the fraction of a foot; thus, $12\times\frac{2}{3}=8$ feet.

Note 2.—In order to find the number of feet in any pile or lot of lumber, the most accurate method is to find the number of square feet in one board; multiply this by the number of boards in the pile or lot.

Ex. Required, the number of square feet in a lot of boards numbering 42, each board being 14 feet by 10 inches. Ans. 490.

Note 3.—Divide the number of square feet by one hundred, or simply separate 2 figures on the right hand, the figures on the left will express the number of hundreds, and those on the right the fraction of a hundred.

Rem. It is customary, I believe, to buy and sell inch boards and those less than an inch in thickness at the same price.

TO MEASURE LUMBER MORE THAN AN INCH THICK.

CXXXVIII. Let it be required to find the number of

square feet in a piece of lumber measuring 12 feet by 6 inches, 2 inches thick?

Analysis. Now, it is obvious that if the board were 12 inches or one foot broad, there would be as many square surface feet as there are linear feet; but as the board is but 6 inches, or one-half foot wide, it will require 2 feet in length to make one square foot; then, if we divide the number of feet 12×2, the quotient will be the number of square surface feet in the board, regarding it as an inch board; but, the board is two inches thick, consequently it would make 2 such boards if split or divided into two, each one of which would contain 12 square surface feet. Now, by multiplying the number of surface feet in the board by 2, the product will be equal to the sum of two such boards one inch thick; thus, $6 \times 2 = 12$. Hence we have the following

Rule II.—Find the square surface feet by rule I; multiply the number of feet thus found by the thickness of the board expressed in inches, and the product will be the number of feet sought.

Ex. How many feet are there in 3 pieces of lumber 15 feet long 10 inches wide and 3 inches thick? Ans. $112\frac{1}{2}$ ft.

Operation, $15 \times \frac{5}{6} = 12\frac{1}{2}$ feet $\times 3$ inches $= 37\frac{1}{2}$ number of feet in one piece; $37\frac{1}{2} \times 3$ pieces $= 112\frac{1}{2}$ feet.

The correctness of this rule may be tested by resolving each piece of lumber into 3 inch boards making 9, and finding the number of 9 inch boards of equal dimension, which will equal the number of feet found in the example above; thus, $15 \times \frac{5}{6} = 12\frac{1}{2} \times 9 = 112\frac{1}{2}$, the number of feet sought.

2. What will a lot of lumber amount to containing 25 pieces 14 feet long, 8 inches wide and 3 inches thick, at $1 per hundred feet? Ans. $7.

3. Required the cost of a lot of inch boards numbering 72, each measuring 12 feet by 9 inches, at 87½ cents per hundred? Ans. $5.67,

Note 1.—If a fraction occur in the thickness of a board, reduce it to an improper fraction, and proceed as before; thus required the number of feet in a board 12 feet long 8 inches wide, and 1½ inches thick. Ans. 12 feet.

Operation, $12\times\frac{3}{3}=8$; $8\times1\frac{1}{2}=\frac{3}{2}=12$ feet.

Note 2.—*If the board is tapering, take half the sum of the width of its ends for its width.*

Ex. What are the contents of a tapering board 20 feet long one of whose ends is 24 inches wide, and the other 10 inches? Ans. 20 feet.

Operation, $14+10=24\div2=12$; 12 in.=1 foot$\times20=20$ ft.

Note 3.—If the plank, joist, &c., is tapering in width, take half the sum of the width of the ends for the width, and, if the tapers be both of the width and thickness, the common rule of obtaining the contents in cubic feet is *to multiply half the sum of the areas of the two ends by the length, and divide the product by* 144.

Ex. How many feet in a beam 20 feet long 10 in. thick whose width tapers from 18 to 16 inches. Ans. 283⅓ feet.

Operation, $18+16=34\div2=17\times20=340\div12=28\frac{1}{3}\times10=283\frac{1}{3}$.

MENSURATION OF LOG OR ROUND TIMBER.

CXXXIX. *When the log is of uniform girth.*

Rule I.—Multiply the area of one end by the length of the log, and the product will be the number of cubic units

Ex. How many solid feet in a log 21 in. in diameter and 16 feet long? Ans. 38½ feet.

Operation, 21 in.$=\frac{7}{4}$ of a foot$\times\frac{22}{7}=5\frac{1}{2}\times\frac{7}{4}=\frac{77}{8}\div4=\frac{77}{32}\times16=38\frac{1}{2}$. $38\frac{1}{2}$. (See rule IV for finding the area of the circle.)

When the log is not of uniform girth.

Rule II.—Multiply the length taken in feet by the square, of $\frac{1}{4}$ *of the mean girth taken in inches, and this product divided by* 144 *will give the contents in cubic feet.*

Ex. If a stick of timber is 50 feet long, and its mean girth 56 inches; what number of cubic feet does it contain? Ans. $68\frac{1}{18}$.

Operation, $56 \div 4 = 14 \times 14 = 196 > 50 = 9800 \div 144 = 68\frac{1}{18}$.

Note 1.—The girth of a tapering log is usually taken about $\frac{1}{3}$ the distance from the larger to the smaller end.

Note 2.—The above rule is not perfectly accurate, though it is the one generally used by business men.

2. How many cubic feet in a stick of timber which is 30 feet long, and whose mean girth is 40 in.? Ans. $20\frac{5}{6}$ feet.

3. How many cubic inches in a log of wood 24 feet long, and whose mean girth is 22 inches?

MENSURATION OF SOLIDS OR VOLUMES.

CLX. This measure is used for finding the solid contents of bodies, and capacity of rooms, boxes, &c., and involves three dimensions, namely: length, breath, and thickness; hence, to find the solid contents of bodies, we have the following

Rule.—Multiply the three dimensions together, and the product will be the cubic units sought, whether inches, feet, yards, &c.

Ex. How many cubic inches are there in a block of wood 6 in. long, 4 in. wide, and 3 in. thick? Ans. 72 inches.

Operation, $6 \times 4 = 24 \times 3 = 72$.

Proof. Divide the solid contents by the product of two of the dimensions, and the quotient will be the other; thus, $72 \div \overline{4 \times 3} = 12 = 6$ and so on.

2. What would it cost to dig a cellar 20 feet long, 8 feet wide, and 6 feet deep, at 2 cents per solid foot? Ans. $16.80.

3. What will a pile of wood come to, 16 feet long, 8 feet high, and 4 feet thick, at $2 per cord? Ans. $8.

CRIB AND BOX MEASURE.

CLXI. *To find the number of bushels which a box, crib, or bin will contain.*

Rule.—Multiply the number of cubic feet by $\frac{4}{5}$, *and the product will be the number of bushels sought.*

Ex. How many bushels of grain can be put into a box 6 feet long, 4 feet wide, and 3 feet deep? Ans. 57 bushels, 2 pecks, $3\frac{1}{3}$ quarts.

Note.—If the corn is in the ear to find the number of bushels in shelled corn, *multiply by* $\frac{2}{5}$ *instead of* $\frac{4}{5}$.

Ex. How many bushels of corn will a crib hold 20 feet, 6 in. long, 4 ft. wide, and 8 feet high? Ans. $262\frac{2}{5}$ bushels.

Operation, 20 feet 6 in.$=20\frac{1}{2}$ feet$\times 4=82\times 8=656\times\frac{2}{5}=$ $262\frac{2}{5}$ bushels.

Note 2.—Though the above rule is not perfectly accurate, yet it is sufficiently so for all practical purposes; in order to be perfectly accurate, the solid contents of the crib or box to be measured, must be reduced to cubic inches, and divided by $2150\frac{21}{50}$, the number of cubic inches in a bushel.

TO FIND THE CONVEX SURFACE OF A CONE OR PYRAMID.

CLXII. *Rule.—Multiply the perimeter or circumference of the base by half of the slant height, and to the product add the area of the base.*

Ex. What is the convex surface of a cone whose slant height is 20 feet, and the diameter of whose base is 9 feet? Ans. 90 feet.

TO FIND THE VOLUME OF A CONE OR PYRAMID.

CLXIII. *Rule.—Multiply the area of the base by $\frac{1}{3}$ of the altitude.*

Ex. What is the solidity of a cone whose slant height is $12\frac{1}{2}$ feet, and the diameter of whose base is $2\frac{1}{2}$ feet. Ans. 20.45 feet +.

MASON'S AND BRICKLAYER'S WORK.

CLXIV. Mason's work is sometimes measured by the cubic foot, and sometimes by the perch which is $16\frac{1}{2}$ feet long, and $1\frac{1}{2}$ wide, and 1 foot deep, and contain $16\frac{1}{2} \times 1\frac{1}{2} \times 1 = 24\frac{3}{4}$ cubic feet.

TO FIND THE NUMBER OF PERCHES IN A PIECE OF MASONRY.

CLXV. *Rule.—Find the solidity of the wall in cubic feet by the rules given for the mensuration of solids, and divide by* $24\frac{3}{4}$.

Note.—Brick work is generally estimated by the thousand bricks, usual size being 8 inches long, 4 inches wide and 2 or $2\frac{1}{4}$ thick. When bricks are laid in mortar, an allowance of one-tenth is made for the mortar.

Ex. How many perches are there in a wall 100 feet long, 5 feet high, and 2 feet thick? Ans. $40\frac{40}{99}$ perches.

TO FIND THE NUMBER OF BRICK NECESSARY TO MAKE ANY PIECE OF MASONRY.

CLXVI. *Rule.—Find the number of solid feet by the rule already given, divide by the number of inches in a brick reduced to the fraction of a cubic foot, and the quotient will be the number of bricks, but, if an allowance is to be made for mortar, multiply the number of bricks by* $\frac{9}{10}$, *and the product will be the number required.*

Ex. How many brick 8 in. by 4, and 2¼ in. thick, will be required to build the walls of a house 30 feet by 20, 16 feet high, and 18 in. thick; no allowance being made for mortar. Ans. 56,000.

Note.—Add the length and width together, and multiply by 2; the product will be the entire length of the wall.

Operation, $100 \times 16 - 1600 \times \frac{3}{2} = 2400 \div \frac{1}{24} = 56,000$.

Note 2.—In the walls of a house an allowance must be made for doors and windows, which must be determined by the dimensions of the doors and windows given.

2. Required, the cost of a brick wall 150 feet long, 8 feet 6 inches high, 1 foot 4 inches thick, allowing $\frac{1}{10}$ for mortar, at $7 per thousand? Ans. $289.17.

HEIGHTS AND DEPTHS MEASURED BY THE VELOCITY OF FALLING BODIES.

CXLVII. A body falling from any height towards the earth, will fall during the first second 16 feet, and continue to increase in velocity throughout its entire course. The law of acceleration is expressed by the odd numbers 1, 3, 5, 7, &c.

If we take the complement* of three odd numbers, as $\frac{1}{3}$, $\frac{1}{5}$, $\frac{1}{7}$, &c., the relation of the numerator to the denominator will express the comparative increase of velocity during each consecutive second; for instance, in each $\frac{1}{3}$ the numerator expresses the comparative distance a body will fall in the first second, and the denominator the comparative distance in the second second; thus, $\frac{1}{3} = \frac{16}{48}$; hence, if we multiply

* The complement of a number is the quotient of a unit divided by that number.

16 by the odd numbers 1, 3, 5, 7, &c., the product will be the distance the body will fall each successive second; thus :

16 × 1 = 16 first second.
16 " 3 " 48 second "
16 " 5 " 80 third "
16 " 7 " 112 fourth "

256

The sum of these numbers is equal to the distance (256) which a body falls during 4 seconds of time. Now, if we square the time 4 seconds, and multiply the square by 16, it will be equal to the sum of the several numbers; thus, 4×4=16×16=256, the space.

THE TIME IN SECONDS BEING GIVEN TO FIND THE SPACE.

CXLVIII. RULE.—*Square the time expressed in seconds, multiply the square by* 16, *and the product will be the space expressed in linear feet.*

Ex. If we drop a heavy body into a well, and observe the time it is falling to be 3 seconds, required the depth of the well. Ans. 144 feet.

Operation, 3×3=9×16=144.

2. If a body, dropped from the top of a mountain, occupied 5 seconds in falling, required the height of the mountain. Ans. 400 feet.

THE SPACE BEING GIVEN TO FIND THE TIME.

CXLIX. Rule II.—*Divide the space by* 16, *and extract the square root of the quotient, and the root thus found will be the time in seconds.*

Ex. A body has fallen through the space of 400 feet, required, the time. Ans. 5 seconds.

Operation, $400 \div 16 = 25$; the square root of 25 is 5, time required.

Note.—The second rule is the converse of the first, and the two rules mutually prove each other.

DISTANCE MEASURED BY THE VELOCITY OF SOUND.

CI. Philosophers have, by experiments and close observation, discovered that the velocity of sound through the air, at a mean rate, is 1130 feet per second, and that this is not affected at all by loud or low sounds, by clear or cloudy weather, and is but slightly modified by favorable or adverse winds. Hence we have the following

RULE.—*Multiply* 1130 *feet by the time expressed in seconds which elapse between the flash of lightning or gunpowder and the report caused by the explosion, and the product will be the distance in feet.*

Ex. If 30 seconds elapse between the flash of lightning and the report of the thunder, what is the distance of the the cloud? Ans. $6\frac{37}{88}$ miles.

2. If 20 seconds elapse between the flash of powder and the report caused by the explosion of a cannon, what is the distance of the gun?

Note.—If the above rule is not perfectly accurate, it is quite satisfactory in the absence of a better one.

GAUGING OF CASKS.

CLI. Gauging is the process of finding the capacity of casks or other vessels.

Casks are generally considered to be of four varieties.

First class, having the staves nearly straight.
Second, having the staves very little curved.
Third, having the staves of a medium curve.
Fourth, having the staves considerably curved.

TO FIND THE MEAN DIAMETER IN GAUGING.

CLII. The first thing to be done in gauging, is to find the mean diameter; this may be done by observing the following

RULE.—First Class.—*Add the product of the difference between the two diameters* $\times \frac{11}{20}$ *or* .55, *to the head diameter and the amount will be the mean diameter.* Second Class.—*Add the product to the difference* $\times \frac{3}{5}$ *or* .60. Third Class.—*Add the product of the difference* $\times \frac{13}{20}$ *or* .65. Fourth Class.—*Add the product of the difference* $\times \frac{7}{10}$ *or* .70.

TO FIND THE CAPACITY OF CASKS.

CLIII. RULE.—*Multiply the square of the mean diameter in inches, by the length in inches, and the product multiplied by* .0034, *will give the capacity in liquid or wine gallons.*

Ex. Required the capacity in gallons of a cask of the 4th variety whose middle diameter is 35 inches, and head diameter 27 inches, and length 45 inches. Ans. 162.6 gal.

2. How many gallons will a cask of the first class contain whose bung diameter is 30 inches, and head diameters 28 inches, length 42 inches? Ans. 120.92+.

Note.—If the number of cubic inches in any vessel be found, and divided by 231, the quotient will be the number of gallons sought in wine or liquid measure; but, if beer measure, divide by 282, and the quotient will be the gallons in beer measure.

Ex. How many wine gallons will a cubic box contain

that is 10 feet long, 5 feet wide and 4 feet high? Ans. $1,496\frac{8}{77}$ gallons.

2. How many gallons, beer measure, will a cylindric vessel contain whose diameter is 21 inches, and 32 in. deep? Ans. 39 gallons.

MISCELLANEOUS.

CLIV. 1. Required the number of rails 10 feet long, 8 rails to the panel to enclose a field containing 5 acres.

Operation, 5 acres $\times$ 160 rods = 800 rods $\div$ 20 = 40; 40 + 20 = 60 $\times$ 2 = 120 rods, the circumference of the field; 2 panels being allowed to the rod, 120 rods $\times$ 2 = 240 panels, 240 $\times$ 8 = 1,920 rails.

Note.—If the circumference is given, multiply the number of rods by 2, and the product will be the number of panels, which multiplied by the number of rails assigned to the panel, and the product will be the number required; but, if the contents of the field are given in acres, reduce them to square rods, and assume any number as one line not greater than the sum of the two dimensions, and divide the number of square rods by the assumed line or dimension, and the quotient will be the other dimension or line, and then proceed as before. (See the operation.)

CAUSE AND EFFECT.

CLV. A *cause* is that which produces something or causes something to be done; as, men, horses, &c.

2. An *effect* is that which results from an operation of some cause whether known or unknown.

3. Solutions by cause and effect are much to be preferred to the method of statements in proportion.

4. Causes are either simple or compound.

5. Compound causes may be reduced to simple ones by multiplying their elements together.

METHOD OF STATING BY CAUSE AND EFFECT.

CLVI. *Rule.—As the first cause is to the first effect, so is the second cause to the second effect.*

Note 1.—The first and last terms are called the extremes, and those intermediate, the means.

Note 2.—If the unknown quantity fall in the extremes, the product of the extremes must be the divisor, and the product of the means, the dividend, and *vice versa.*

Ex. If 4 men, in 3 days, can build $\frac{1}{4}$ of a wall, what part can 6 men build in 4 days? 4 men and 3 days, the first cause; $\frac{1}{4}$ the first effect; 6 men and 4 days, the second cause; 1, the second effect, $4\times3 :: \frac{1}{4} :: 6\times4 :: 1$ the statement.

Operation, $4\times3=12\times1=12$, divisor; $6\times4=24\times\frac{1}{4}=6$, dividend; thus, $6\div12=\frac{1}{2}$ of the wall, the answer.

2. If 4 men, in 3 days, can build $\frac{1}{4}$ of a wall, how many men must be employed for 4 days to build $\frac{1}{2}$? Statement, 4 men and 3 days $:: \frac{1}{4} :: 1$ and 4 days $:: \frac{1}{2}$. Ans. 6 men.

2. Three carpenters, A, B and C, can build a house in $3\frac{1}{2}$ months; A and B can build it in 4 months in what time can C build it working alone? Ans. 28 months.

Solution, $3\frac{1}{2}=\frac{7}{2}$; $1\div\frac{7}{2}=\frac{2}{7}$, what 3 did in one month; $1\div4=\frac{1}{4}$ what 2 did in one month; $\frac{2}{7}-\frac{1}{4}=\frac{1}{28}$; what C did in one month, if C did $\frac{1}{28}$ in one month, it will require 28 months to complete the work.

Suggestion. This question may be proved by adding what C did to what A and B did, and the sum will be equal to what the three did.

3. How many acres are there in a round field 56 rods in diameter? Ans. $15\frac{2}{5}$ acres.

Solution, $56\times\frac{22}{7}=176\times56=9856\div4=2464\div160$ rods$=15\frac{2}{5}$ acres.

4. If $\frac{1}{3}$ of 6 be 3, what will $\frac{1}{4}$ of 20 be? Ans. $7\frac{1}{2}$.

Solution, $3\div6=\frac{3}{6}=\frac{1}{2}\times3$ third$=\frac{3}{2}\times20=\frac{60}{2}=30\div4=7\frac{1}{2}$.

5. A and B have the same income, A saves $\frac{1}{8}$ of his annually, but, B, by spending \$200 a year more than A, at the end 5 years, finds himself \$160 in debt; what is their income?

Solution. \$160$\div5=32$; $200-32=168\times8=1344$.

6. 2 men, A and B, on opposite sides of a plat of ground 536 yards in circumference, set out at the same time in the same direction, to walk around it; A walks at the rate of 11 yards in one minute, and B, at the rate of 34 yards in 3 minutes; how many times must B walk around before he overtakes A?

Solution. 11×3 min.$=33$ yards; $34-33=1$ yard$\div34=\frac{1}{34}$ the gain on one yard; $536\div2=268$, distance between them; $368\div\frac{1}{34}=9,112\div536=17$, the answer.

7. A fox starts up 50 yards in advance of a greyhound; the dog bounds away in pursuit at the rate of 12 feet a leap; the fox scuds away at the rate of 8 feet a leap; but the fox makes 7 leaps while the dog makes 5; required the distance the dog must run before he overtakes the fox, and the number of leaps each must make. Ans. 2,250 feet, the distance required; $187\frac{1}{2}$ dog leaps; $262\frac{1}{2}$ fox leaps.

Solution, $12\times5=60$; $8\times7=56$; $60-56=4\div60=\frac{4}{60}=\frac{1}{15}$, the gain on one foot; $50\times3=150$ feet distance between; $150\div\frac{1}{15}=2250$, the distance the dog runs; $2250\div12=187\frac{1}{2}$ dog

leaps; 2250—150=2100÷8=262½, the number of fox leaps.

8. A certain young gentleman, it is said, asked an old gentleman for his daughter in marriage, and received the following answer; there are 3 gates between us and the orchard; go into the orchard, and gather such a number of apples as will enable you, at the first gate, to leave ½ and ½ an apple over, at the second gate, leave ½ the remainder and ½ an apple over, and at the third gate leave half you have, and ½ an apple over and bring me one apple; do this without dividing an apple and my daughter shall be yours; required the number.

Solution, $1+\frac{1}{2}=1\frac{1}{2}\times 2=3$, the number he had on reaching the last gate; $3+\frac{1}{2}=3\frac{1}{2}\times 2=7$ the number brought to the second gate; $7+\frac{1}{2}=7\frac{1}{2}\times 2=15$, the number required. Reverse the order of procedure, and the proof will be easy; thus, leave 8 at the first gate, 4 at the second, 2 at the third, and 1 is left.

9. A certain man, at his decease, bequeathed to his 3 children, 2 sons and 1 daughter, 459 acres of land to be divided among them as follows: the younger son's portion must equal $\frac{4}{5}$ of the elder son's, and the daughter's, $\frac{3}{4}$; required the share of each

Solution, $\frac{5}{5}+\frac{4}{5}+\frac{3}{4}$ reduced to a common denominator= $\frac{20}{20}, \frac{16}{20}, \frac{15}{20}=\frac{51}{20}$; since the denominators are alike they are cancelled, and, as the sum of numerators, expresses the number of parts into which the given number is to be divided, it may be transferred to the denominator; thus, $\frac{20}{51}, \frac{16}{51}$ and $\frac{15}{51}$; now, the numerators express the proportional parts to be taken thus, 459÷51=9×20=180, the elder son's share; 9×16=144, the younger son's share; 9×15=135, the daughter's share.

Proof, 180+144+135=459; but, according to the condition of the question, the younger son's share must be $\frac{4}{5}$ of the elder son's; the daughter's, $\frac{3}{4}$, thus $\frac{144}{180}=\frac{4}{5}$; $\frac{135}{180}=\frac{3}{4}$.

10. A certain man, looking on his watch, was asked the time of day; he replied the time past noon is equal to $\frac{1}{5}$ of the time past midnight; what was the time? Ans. 3 o'clock.

Solution. $\frac{5}{5}-\frac{1}{5}=\frac{4}{5}$; $12\div\frac{4}{5}=15$ hours$-12=3$, the time sought.

11. A man dying, worth \$5,450, left a wife and two children, a son and daughter, absent in a foreign country; he directed if his son returned, the mother should have $\frac{1}{3}$ of the estate, and the son the remainder; but, if the daughter returned, she was to have $\frac{1}{3}$, and the mother the remainder; now, it so happened that they both returned; how must the estate be divided to fulfill the father's intentions?

Solution, 1+2+4=7; \$5,460$\div$7=\$780, daughter's share; \$780$\times$2=1,560, wife's share; \$780$\times$4=3,120, son's share.

12. A traveler found a purse of money; $\frac{1}{2}$ of its contents was silver, $\frac{2}{5}$ gold and \$20 in greenbacks; how many dollars did the purse contain?

Solution, $\frac{1}{2}+\frac{2}{5}=\frac{9}{10}$; $\frac{10}{10}-\frac{9}{10}=\frac{1}{10}=\$20$; $20\times10=200$, number of dollars.

Proof, $\frac{1}{2}$ of 200 = 100, silver;
$\frac{2}{5}$ of 200 = 80, gold;
Greenbacks, = 20

The sum, \$200

RULE FOR EXTRACTING THE SQUARE ROOT.

CLVII. I. *Separate the given number into periods of two figures, commencing at units; the left hand period may contain but one figure.*

II. *Take the square root of the left hand period for the first figure in the root.*

III. *Subtract the square of this from the left hand period, bring down the next period; divide the result, exclusive of the right hand figure, by twice the part of the root already found; the quotient will be the second figure of the root.*

IV. *Set this figure of the root on the right of the divisor; multiply the divisor thus completed by the second figure of the root; subtract the product from the last dividend, and bring down another period.*

V. *Double the root already found for a trial divisor, find another figure of the root, and proceed as before, till all the periods have been brought down.*

Ex. Required, the square root of 2809.

Operation,
$$\begin{array}{r} 2809 \,(53 \text{ square root.} \\ 25 \\ \hline 103)309 \\ 309 \\ \hline 000 \end{array}$$

Proof. Raise the root to the second power, and the result will be equal to the given number; thus $53 \times 53 = 2809$.

Note 1.—Annex periods of naughts to obtain decimals.

Note 2.—The square root of a common fraction, is the equal root of the numerator divided by the square root of the denominator; but, if the denominator is not a square, make it so by multiplying both terms, of the faction by the denominator; or the root may be obtained by reducing the common fraction to a decimal, and extracting the the root as integral numbers.

Two brothers bought a tract of land containing 200 acres, for which they were to pay $800, each paying an equal

sum; but one end of the land being richer than the other, the elder brother proposed to the younger that he would pay 50 cents more per acre if he would let him have the better portion ; this being agreed to, required the number of acres each should receive, and the price per acre.

Ans. { Elder brother's, 93¼+acres.
Younger brother's, 106¼ acres, nearly.
Price of elder brother's, $4.265+.
Price of younger brother's, $3.765+.

RULE FOR SOLUTION.

CLVIII. *Divide half the whole cost by the whole number of acres, and to the square of the quotient add the square of half the difference of the price per acre; then extract the square root of the sum, and to this root add the quotient of half the whole cost, divided by the whole number of acres. This last sum increased by half the difference of the price per acre, will give the price per acre of the best land, and diminished by the same, will give the price per acre of the poorest land.*

LEGAL FORMS

NECESSARY IN ORDINARY BUSINESS,

PREPARED BY

RICHARD WATT YORK, A. M.

Attorney and Counsellor at Law.

AFFIDAVIT.

NORTH CAROLINA, }
Chatham County, }

Personally appeared before me, *John Doe*, a Justice of the Peace in and for the County and State aforesaid, *Richard Roe*, who being duly sworn doth depose and say that [*insert here the facts as they exist.*]

JOHN DOE, *J. P.*

AGREEMENT.

Articles of agreement made, entered into, and concluded upon this the — day of ——, 187—, between *John Doe*, of the first part, and *Richard Roe*, of the second part:

First, for and in consideration of [*here insert the consideration as it exists whether money, property, work, &c.,*] to said *John Doe*, paid by *Richard Roe*, the said *John Doe* covenants, promises and agrees to [*here insert the agreement on the part of the first party.*]

Second, for and in consideration of [*here insert the consideration as it exists whether money, property, work, &c.,*] to *Richard Roe* paid by *John Doe*, the said *Richard Roe* covenants, promises and agrees to [*here insert the terms of the agreement.*]

And the said *John Doe* and *Richard Roe*, for themselves, their heirs, executors and assigns, mutually covenant, promise and agree the one with the other, that they will severally perform the stipulations as above mentioned by them respectively assumed.

In witness whereof, the said *John Doe* and *Richard Roe* have hereunto set their hands and seals, the day and date above written.

Sealed and delivered in the presence of —— ——. } JOHN DOE, [*Seal.*] RICHARD ROE, [*Seal.*]

AGREEMENT FOR THE SALE OF AN ESTATE IN LAND.

Articles of agreement entered into, made and concluded, this the — day of ——, 187—, between A. B. and C. D.

The said A. B. agrees to sell to the said C. D. all that tract or parcel of land, with the appurtenances thereunto belonging, known as the——place, bounded as follows, beginning at [*here insert the boundaries,*] containing —— acres, more or less, for the sum of —— dollars; and, on receipt of said sum of money on or before the — day of ——, 187—, the said A. B. will execute a good and sufficient title at law and in equity in fee simple to the said C. D. with a covenant of general warranty as to title and against encumbrances, to the said C. D., his heirs and assigns.

And the said C. D. agrees that, upon the due and proper execution of a good and sufficient conveyance in fee simple, he will pay the said the sum of ——— dollars to the said A. B. or his assigns.

In testimony of all which things the said A. B. and C. D.

have signed their names, and affixed their seals, the day and date above specified.

In the presence of } A. B., [*Seal.*]
E. F., } C. D., [*Seal.*]
G. H. }

ARTICLES OF AGREEMENT TO FORM A COPARTNERSHIP.

Articles of agreement made and concluded on this the — day of ——, 187—, between *John Den* and *Richard Fen.*

First, the said *John Den* and *Richard Fen* have agreed and, by these presents do hereby agree, to form a partnership under the name and style of *Den* and *Fen* for the purpose of carrying on the business of —— at ——.

Second, the capital stock shall consist of —— dollars, of which amount *John Den* is to advance —— dollars, and *Richard Fen* is to advance. [*any other agreements may be inserted as the facts in the case may justify.*]

The said partnership shall continue from the — day of ——, 187—, until the — day of ——, 187—.

In testimony whereof, &c.

ASSIGNMENTS.

A general form of assignments by indorsement on the back of any instrument, whether, Agreement, Mortgage, Bond, &c., conveying personal property.

Know all men by these presents, that, I, the within named *John Doe*, for and in consideration of the sum of one dollar to me paid by *Richard Roe*, have assigned to the said

Richard Roe all my interest in the within written instrument, and every clause, article, or thing therein contained. [*where necessary the following short form of power of attorney, may be added,*] and I constitute the said *Richard Roe*, my attorney, in my name and to his own use, to take all necessary legal proceedings for the complete recovery and enjoyment of the premises hereinbefore assigned, with power of substitution.

Witness my hand and seal, the — day of ——, 187—.

JOHN DOE, [*Seal.*]

ASSIGNMENT, BY INDORSEMENT, OF A MORTGAGE IN FEE.

Know all men by these presents, that I, the within named *John Den*, in consideration of the sum of —— dollars to me paid by *Richard Fen*, receipt of which is hereby acknowledged, &c., have granted, assigned, released, and conveyed, and by these presents do hereby grant, assign, release and convey unto the said *Richard Fen* the premises and lands within conveyed to me in mortgage, and all my right, title, interest, and estate in and unto the same. To have and to hold to the said *Richard Fen*, his heirs and assigns forever.

[*Clauses of warranty, against encumbrances, for further assurance of title, &c., may be added as in a common deed, if necessary.*]

Witness my hand and seal, the — day of ——, 187—.

In the presence of } JOHN DEN, [*Seal.*]
—— ——. }

ABSOLUTE ASSIGNMENT OF AN ORDER BY INDORSEMENT.

I, the within named *John Doe*, do hereby assign end transfer all my right, title and interest in and to the within written order, and the moneys secured thereby unto *Richard Roe* and his assigns. This the -- day of ——, 187—.

In the presence of } JOHN DOE.
—— ——. }

AWARD OF ARBITRATORS.

To all to whom these presents shall come:—greeting.

Know ye, that whereas, *John Den*, of the County of Chatham, and *Richard Fen*, of the County of Wake, did, on the - - day of ——, 187—, enter into a bond in the sum of —— dollars, conditioned to stand to and abide by the award and decisions of the arbitrators in a certain controversy between them, [*or did mutually agree to stand to and abide by, when no bond has been entered into.*]

Now, therefore, be it remembered, that on the — day of ——, 187—, the undersigned arbitrators did hear and examine the said parties, and, having maturely and impartially considered all the matters involved therein, do make this our award and decision, to-wit:

1st. We do award that *John Den* [*state the award in plain languages.*]

2d. We do further award that *Richard Fen* [*here state again the award in plain language, and, in separate numbered items state all the various awards.*]

Given under hand and seal, the — day of ——, 187—.

WM. SCOTT, }
THOS. SHOTT, } *Arbitrators.*

BILL OF SALE, WITH CLAUSE OF WARRANTY.

NORTH CAROLINA, }
Chatham County. }

Know all men by these presents, that I, Richard Roe, for and in consideration of the sum of ——— dollars, to me paid by Jno. Doe, do hereby grant, assign, convey and transfer unto the said Jno. Doe (*here mention the property conveyed,*) to have and to hold to the said Jno. Doe, his executors, administrators, and assigns forever. And I do covenant for myself, my executors, adminstrators and assigns, to and with the said Jno. Doe, his executors, administrators and assigns, to warrant and defend the title hereby conveyed from the lawful claim of any and all persons whatsoever. (If this Bill of Sale is given by a sheriff or constable, he should recite in the first part the fact of the sale under execution, and after the word "*whatsoever,*" add the words, "*so far as my office and duty as* (sheriff or constable) *requires, and no further.*)

Witness my hand and seal the — day of —, 187 .

RICHARD ROE, [L. S.]

Signed, sealed and delivered in }
the presence of ———. }

BOND—SIMPLE.

$100.00. ——— after date, I promise to Jno. Jones one hundred dollars for value received. Witness my hand and seal the — day of —, 187 .

JOSEPH STARK, [L. S.]

In the presence of ———.

SIMPLE BOND WITH PRINCIPAL AND SURETY.

Twelve months after date, with interest from date, we, Jno. Den as principal and Richard Roe and Richard Fen as sureties, promise to pay Jno. Doe one thousand dollars for value received. Witness our hands and seals, the — day of —, 187 .

JNO. DEN, [L. S.]
RICHARD ROE, [L. S.]
RICHARD FEN, [L. S.]

In the presence of ————.

BOND WITH CONDITION.

Know all men by these presents, that I, John Den, am held and firmly bounden unto Richard Fen in the sum of one thousand dollars, to the which payment, to be well and truly made, I bind myself, my heirs, executors and administrators.

Sealed with my seal the — day of —, 187 .

The condition of the above obligation is such, that whereas, John Den hath agreed [*to deliver unto Richard Fen* 100 *bales of cotton, weighing not less than* 400 *lbs. each, on or before the first day of December*, 187 .] Now if the said Jno. Den shall well and truly [*deliver the cotton as hereinbefore recited.*] then this obligation to be null, void, and of no effect, otherwise of full force and effect.

Witness my hand and seal the — day of —, 187 .

JNO. DEN, [L. S.]

In the presence of ————.

LIEN BOND UNDER ACT OF MARCH 1ST, 1867.

North Carolina, }
Chatham County. }

Whereas, A. B., of the county of ——, N. C., has agreed to make advances of supplies to C. D. for the purpose of agriculture during the year 187 , to the value and amount of —— dollars; and whereas, as the said C. D. desires to secure to the said A. B. the said sum in accordance with the terms of the Act of the General Assembly of North Carolina, entitled "An Act to secure advances for agricultural purposes," ratified the 1st day of March, 1867; therefore, in consideration thereof, C. D. as principal, and E. F. and G. H. as sureties, do hereby agree with the said A. B. that he shall have an interest in and lein upon the crops of ——— and other products to be raised during the year 187 , upon the lands of —— in the county of ——, occupied and to be cultivated by C. D. during the said year 187 to the full value of the advances to be made as aforesaid. And for further security, the said C. D. hereby bargains and sells to the said A. B. the following articles of personal property now in the possession of the said C. D., with the understanding that if the said C. D. shall well and truly pay to the said A. B. the sum advanced on or before the — day of — 187 , then the said lien shall be discharged, and the said property revert in C. D.: otherwise the said A. B. shall have power to take into his possession said crop and other property, and sell the same for cash after ten days notice.

In testimony of all which things the said parties have hereunto set their hands the — day of ——, 187 .

A. B.
C. D.
E. F.
G. H.

In the presence of ————.

FORTHCOMING BOND.

North Carolina, }
—— *County.* }

Know all men by these presents, that we ————and ———— are held and firmly bounden unto ———, sheriff (*or constable*) of ——— county, in the sum of ——— dollars, to which payment well and truly to be made, we bind ourselves, our heirs, executors and administrators, jointly and severally. Sealed with our seals the — day of ——, 187 .

The condition of the above obligation is, that whereas the said ———, sheriff (*or constable*) as aforesaid, hath this day levied an execution in favor of ——— against the above bounden ——— upon the following personal property of the said ———, to-wit: (*here set out the various articles of property,*) and hath permitted said property to remain in the possession of the said ———; now, therefore, if the said ———, on the — day of —, 187 , the day of sale appointed for the same, or upon any other day to be hereafter named by the said ———, sheriff (*or constable*) as aforesaid, shall well and truly deliver to said ———, sheriff (*or constable*) as aforesaid, all the said personal property to answer said execution; then the above obligation to be null and void: otherwise to remain in full force and virtue.

————, [L. S.]
————, [L. S.]
————, [L. S.]

In the presence of ——.

COVENANTS.

The following forms may be inserted in Deeds as the various cases may require :

Of one Person with one Person.

And the said Jno. Den, for himself, his heirs, executors and administrators, and for each and every of them, doth covenant with the said Richard Fen, his heirs, executors and administrators, that [*here insert the covenant in plain language.*]

N. B. Sometimes the word "*assigns*" should be added after the name of the *covenantee.* In covenants respecting personal property the word "*heirs*" should be omitted. Its insertion, however, can do no harm, and it is bettter that unprofessional persons should always insert it. Such persons also, out of abundance of caution, might use the word "*assigns*" after the *covenantee,* thus: "with the said Richard Fen, his *heirs, executors, administrators and assigns.*"

A Joint Covenant with one Person.

And the aforesaid Jno. Doe, Richard Roe and Jno. Den, for themselves, their heirs, executors and administrators, and for each and every of them, do covenant with the aforesaid Richard Fen, his heirs, executors, administrators (and assigns,) that, &c.

A Joint and Several Covenant.

Same as above, except as follows: "do jointly and severally covenant," &c.

NOTE.—All the usual covenants in a deed will be found under "*Deeds.*"

DEEDS.

Deed Poll, with Covenants of Title, Warranty, &c.

NORTH CAROLINA, }
Chatham County. }

Know all men by these presents, that I, Jno. Doe, of the county and State aforesaid, in consideration of ——— dollars to me paid by Richard Roe, the receipt of which is hereby acknowledged, have bargained and sold, granted and conveyed, and, by these presents, do give, grant, convey, bargain and sell unto Richard Roe, his heirs and assigns, all that tract or parcel of land situated in ——— county and State of ——, lying upon the waters of ———, and bounded as follows, to-wit: beginning at [*here set out the boundaries and description of the land,*] containing ——— acres, more or less; together with all the rights, ways, privileges and appurtenances in anywise to said land appertaining and belonging. To have and to hold the above-mentioned lands and premises to the said Richard Roe, his heirs and assigns, to his and their use and behoof forever.

And I, the said Jno. Doe, for myself, my heirs, executors and administrators, do covenant with the said Richard Roe, his heirs and assigns, that I am lawfully seized in fee simple of the aforegranted lands and premises: that they are free from all encumbrances of any and every kind whatsoever: that I have a good right to sell and convey the same to the said Roe as aforesaid; and that I will, and my heirs, executors and administrators shall, warrant and defend the same to the said Richard Roe, his heirs and assigns forever, against the lawful demands of all persons whatsoever.

In testimony of all which things I have hereunto set my hand and seal the — day of ——, 187 .

JNO. DOE, [L. S.]

Signed, sealed and delivered in the presence of
JNO. DEN,
RICHARD FEN.

DEED INDENTED OR INDENTURE IN FULL WITH ALL THE USUAL COVENANTS.

This indenture made the — day of ——, 187—, between John Doe, of —— party of the first part, and Richard Roe, of —— party of the second part:

Witnesseth, that the said party of the first part, for and in consideration of the sum of —— dollars, lawful money of the United States, to him paid by the said party of the second part, at or before the ensealing and delivery of these presents, the receipt of which is hereby acknowledged, and the said party of the second part, his heirs, executors, and administrators forever released and discharged from the payment of the same, by these presents hath given, granted, bargained, sold, aliened, remised, released, confirmed, and conveyed, and by these presents, doth give, grant, bargain, sell, alien, remise, release, and convey to the said party of the second part, his heirs and assigns, all that tract or parcel of land, situate in the County of —— and State of ——, lying upon the waters of——— and bounded as follows, to wit: beginning at [*here set out the boundaries and descriptions of the land,*] together with all and singular the tene-

ments, hereditaments, and appurtenances thereunto belonging, or in auywise whatsoever appertaining; and the reversion and reversions; remainder and remainders; rents; issues; and profits thereof; and, also all the estate, right, title, interest, property, possession, claim, and demand whatsoever, as well at law as in equity, of the said party of the first part, of, in, and to the aforegranted lands and premises with the appurtenances thereunto belonging.

To have and to hold the aforementioned lands and premises to the aforesaid party of the second part, his heirs and assigns, to his and their own proper use and behoof forever.

And the said John Doe, party of the first part as aforesaid, for himself, his heirs, executors, and administrators, doth covenant with the said Richard Roe, party of the second part as aforesaid, his heirs, and assigns, that the aforesaid John Doe at the time of the ensealing and delivery of this indenture, was lawfully seized in his own right of a good, absolute, and indefeasible estate of inheritance, in fee simple, of, in, and to, all and singular the lands and appurtenances hereinbefore conveyed; and has good right, full power, and lawful authority to bargain, sell and convey the same in manner and form as aforesaid; and, that the said party of the second part his heirs and assigns shall and may, at all times hereafter peaceably and quietly have, hold, use, possess, occupy, and enjoy the above conveyed lands and premises with the appurtenances thereunto belonging, without any let, suit, trouble, molestation, eviction, or disturbance, of the said party of the first part, his heirs and assigns, or of any other person or persons lawfully claiming the same; and, that the aforesaid lands and

tenements now are free, clear, and discharged, and unencumbered of and from all former grants, titles, charges, estates, judgments, taxes, assessments and encumbrances of whatsoever kind or nature; and, that the said party of the first part and his heirs, and all and every person or persons whosoever lawfully or equitably deriving any estate, right, title or interest of, in, or to, the hereinbefore-granted lands and premises, by, from, or under, or in trust for them or either of them, shall and will, at any time or times hereafter, upon the reasonable request of the aforesaid party of the second part, his heirs and assigns, and at the proper costs and charges of the said party of the second part, his heirs and assigns, make, do, and execute, or cause to be made, done, and executed, all and any such further and other lawful and reasonable acts, conveyances, and assurances in the law, for the better and more effectually vesting and confirming the lands and premises hereinbefore conveyed, and so intended to be in, and conveyed to, the said party of the second part, his heirs and assigns forever, as by the said party of the second part, his heirs and assigns, his or their counsel learned in the law, shall be reasonably advised and required.

And the said *John Doe*, his heirs, executors and administrators, the above-described lands and premises hereinbefore conveyed, with the appurtenances thereunto belonging, to the said party of the second part, his heirs and assigns, against the said party of the first part, his heirs and assigns, and against all and every and person or persons whomsoever lawfully claiming or to claim the aforesaid lands and premises, shall and will warrant and by this indenture forever defend.

In testimony of all which things the said party of the first part both hereunto set his hand and affixed his seal, this the — day of ———, A. D., 187—.

Signed, sealed and delivered in the presence of
JOHN DEN,
RICHARD FEN.

JOHN DOE, [*Seal.*]

DEED OF QUIT-CLAIM.

This Indenture made the — day of ——, A. D., 187—, between *John Doe*, of ———, and *Richard Roe*, of ———.

Witnesseth, that the said *John Doe*, for and in consideration of the sum of ——— dollars, to him paid by the said *Richard Roe*, receipt of which is hereby acknowledged, hath released, remised, and quit-claimed, and, by these presents, doth hereby remise, release, and quit-claim unto *Richard Roe*, his heirs and assigns forever, all that tract or parcel of land situated in the County of ——— and State of ———, lying upon the waters of ——— and bounded as follows, to wit: beginning at [*here insert the description and boundaries,*] containing ——— acres, more or less; together with all and singular the tenements, hereditaments, and appurtenances thereunto belonging; and all right, title, or estate, claim and demand whatsoever, as well at law as in equity, of the said *John Doe* of, in, and to, the above-described premises.

To have and to hold all and singular the above-mention-

ed lands and premises unto the said *Richard Roe*, his heirs and assigns forever.

In witness whereof, &c.

Signed, sealed and delivered in the presence of
JOHN DEN,
RICHARD FEN.

JOHN DOE, [*Seal.*]

NOTE.—Whenever *interlineations*, *additions* or *erasures* are made in drafting a deed, the fact should be noticed at the foot of the deed thus "*all interlineations, erasures and additions made before signing and sealing.*"

NOTE.—No forms are inserted for deeds of married women, sheriff's, clerk's, administrators and other officers of the law. They always depend on circumstances for their form. In all such cases, counsel learned in the law should be consulted, and the deed drafted by them.

DEED IN TRUST.

This Indenture, in three parts, made the — day of ——, A. D., 187—, between *John Doe*, of the first part, *Richard Roe*, of the second part, and [*here should be inserted the names of the party or parties for whom the trust is created, in case of creditors it will be sufficient to say "creditors of the said* John Doe,"] of the third part.

Witnesseth, that the said *John Doe*, party of the first part, for and in consideration of the sum of ——— dollars, [*generally a nominal sum of "one," "five" or "ten" dollars,*] to him paid by *Richard Roe*, party of the second part, receipt of which is hereby acknowledged, hath bargained and sold,

and, by these presents, doth bargain and sell unto the said *Richard Roe*, of the second part, his heirs and assigns, all that tract or parcel of land, situate in the County of ——— and State of ———, lying upon the waters of ———, and bounded as follows: beginning at [*here insert boundaries and descriptions,*] containing ——— acres, more or less, [*if personal property, also is conveyed, insert as follows "and the following personal property, to-wit:" setting it forth explicitly.*]

To have and to hold to the said *Richard Roe*, of the second part, his heirs and assigns forever.

In trust, nevertheless, that [*here insert the trusts in plain language. If, for creditors, state all the duties which the trustee is to perform, such as time, place, manner of sale, &c.*]

And the said *John Doe*, of the first part, for himself, his heirs, executors and administrators, covenants with the said *Richard Roe*, of the second part, his heirs and assigns, that he is lawfully seized in fee of the above described property and premises; that they are free from encumbrances; that he has good right and title to sell and convey the same; and that he will, and his heirs, executors and administrators, shall warrant and defend the title to the same to the said *Richard Roe*, of the second part, his heirs and assigns forever against the lawful demands of all persons.

And the said *Richard Roe*, of the second part, for himself, his heirs, executors and administrators, covenants with the said *John Doe*, of the first part, his heirs and assigns, that he will well, truly and faithfully perform the duties and trusts emunerated and specified in this deed.

In testimony of all which things the said *John Doe* and

the said *Richard Roe* have hereunto set their hands and seals, the — day of ———, A. D., 187—.

Signed, sealed and delivered in the presence of
JOHN DEN,
RICHARD FEN.

JOHN DOE, [*Seal.*]
RICHARD ROE, [*Seal.*]

DEED IN MORTGAGE.

This Indenture made this the — day of ———, A. D., 187—, between *John Den*, of the first part, and *Richard Fen*, of the second part.

Witnesseth, that the said *John Den*, for and in consideration of the sum of one dollar to him paid by *Richard Fen*, of the second part, receipt of which is hereby acknowledged, and the further considerations which, in this deed, hereinafter appear, hath bargained and sold, and, by these presents, doth bargain and sell unto the said *Richard Fen*, his heirs and assigns all that tract or parcel of land situate in the County of ——— and State of ———, lying upon the waters of ——— and bounded as follows, to-wit: beginning [*here insert the descriptions and boundaries,*] containing ——— acres, more or less. [*If personal property also is conveyed, then add here "and the following personal property, to-wit," setting it forth explicitly.*]

To have and to hold to the aforesaid *Richard Fen*, his heirs and assigns forever.

And the said *John Den*, for himself, his heirs, executors and administrators doth covenant with the said *Richard Fen*, his heirs and assigns, that he, the said *John Den*, is lawfully seized in fee simple of the above described prop-

erty and premises; that the same is free from all encumbrances; that he has good right to sell and convey the same; that he will, and his heirs, executors, and administrators, shall, warrant and defend the same to the said *Richard Roe*, his heirs and assigns forever against the lawful demands of all persons whomsoever.

ON CONDITION, NEVERTHELESS, [*that if the said Jno. Den, his heirs, executors and administrators shall well and truly pay to the said Richard Fen, his executors, administrators and assigns, the sum of ——— dollars on or before the — day of ——, 187 , with the interest, costs and charges thereon accrued,*] then this deed and conveyance to be null, void, and of no effect; otherwise to remain in full force and effect. [*If a power of sale is conferred, then add here as follows: "and if the said sum of money, or any portion thereof, hereinbefore recited, shall be and remain unpaid at the date aforesaid, then the said Richard Fen and his assigns shall have power to sell the same in manner and form as follows," stating the terms, time, manner, &c., of the sale.*]

And the said Richard Fen of the first part, for himself, his heirs, executors, administrators and assigns, covenants with the said Jno. Den of the second part, his heirs, executors, administrators and assigns, that he will well and truly perform all stipulations contained in this deed and imposed upon him by the same.

In witness whereof, the said Jno. Den of the first part, and the said Richard Fen of the secornd part, have hereunto set their hands and seals the — day of ——, A. D., 187 .

Signed, sealed and delivered in the presence of
JNO. DOE,
RICHARD ROE.

JNO. FEN, [L. S.]
RICHARD FEN, [L. S.]

NOTE.—After the words "*on condition, nevertheless, that,*" in the above deed, the conditions should be set out in plain and explicit language in that portion included between [ ] according to the circumstances which give rise to the mortgage.

CHATTEL MORTGAGE.

I, Jno. Doe, of the county of ———, and State of ———, am indebted to Richard Roe, of the county of ——, and State of ———, in the sum of ——— dollars due by [*here state whether by open account, note, &c.,*] which will be due on the — day of ——, 187 , and to secure the due payment of the same, I hereby convey to him the following articles of personal property, to-wit: [*here set out the articles explicitly.*]

ON CONDITION, NEVERTHELELS, that if I fail to pay said debt and interest on or before the — day of ——, A. D., 187 , then he may sell said property, or so much thereof as may be necessary to satisfy said debt, by public auction for cash, after having first given twenty days' notice at three public places, and apply the proceeds of said sale to the discharge of said debt, and pay the surplus, if any, to me.

Witness my hand and seal this the — day of ——, A. D., 187 .

JNO. DOE, [L. S.]

In the presence of
JNO. DEN,
RICHARD FEN.

LEASE.

This Indenture made, this the — day of ——, A. D. 187—, between *John Doe*, of ———, and *Richard Roe*, of ———, witnesseth that the said *John Doe* doth hereby demise, lease, and to farm let, unto *Richard Roe*, that piece or parcel of land known as [*here describe the premises which are the subject of the lease,*] to hold for the term of ——— years from the — day of ——, A. D., 187—, during the said term unto the said *Richard Roe;* yielding and paying, unto the said *John Roe* or his assigns as rent and render therefor [*here insert what the lease is to pay for the use of the premises, whether a part of the crop, money, &c., and when to be paid, whether yearly, half-yearly, quarterly, monthly, &c. State all these plainly and fully.*]

I. And the said *Richard Roe* covenants and agrees to pay the rent as aforesaid in manner as aforesaid, to the said *John Doe* or his assigns; and to deliver up the premises to the said *John Doe* or his attorney, at the end of the term, in as good condition as when received, reasonable wear and tear from the use thereof, and casualty from fire, tempest and other unavoidable cause, being excepted: that the said *John Doe*, his attorney, or assigns may, at all times, enter the premises to view the same and make improvements thereon at reasonable times.

II. The said *John Doe* covenants that the said *Richard Roe* shall have quiet and peaceable possession during the said term, and that he will warrant and defend the title against the claims of all persons as to the possession of the said premises during the said term.

In witness of all which things the said *John Doe* and

Richard Roe have hereunto signed their names and affixed their seals, the — day of ———, 187—.

In the presence of
JOHN DEN,
RICHARD FEN.

JOHN DOE, [*Seal.*]
RICHARD ROE, [*Seal.*]

NOTE.—Other covenants may be inserted as may be agreed on by the parties, the forms of which will be found below. The covenant of the lessor for quiet enjoyment and defense of title, as a matter *of form only*, should come last in the deed.

Covenant to pay taxes.

And the said *Richard Roe* covenants and agrees to pay all taxes and duties lawfully imposed and levied on the premises demised and let unto him during his said term.

Covenant not to commit waste.

And the said *Richard Roe* covenants that he will not commit waste on the demised premises.

Covenant not to underlet.

And the said *Richard Roe* covenants and agrees that he will not underlet the said demised premises, or any part thereof, nor permit any other person or persons to occupy the same or any part or portion thereof without the consent [*"in writing," if the parties so agree,*] of the said *John Doe* or his assigns.

Covenant under the "Act of 1868–'9, *Secs.* 13 *and* 14, *Laws of North Carolina, giving the Lessor a Lien on the Crop as a security for the rent.*

And the said *Richard Roe*, for himself, his executors and administrators, covenants and agrees with the said *John Doe*

and his assigns, that the said *John Doe* shall have a lien upon the crops to be grown upon the aforesaid demised premises, and the said *Roe* as aforesaid hereby transfers, and assigns to the said *John Doe*, all his right, title, and interest in the crops to be grown on the premises as aforesaid for the sole purpose of constituting a lien and security on said crop for the rents which may be now due, or may hereafter become due during the said term, as well as, and also for the due and faithful performance of each, every, and all stipulations contained in the said dead of demise and lease.

LIEN LAW—ACT OF 1869–'70—FORM OF NOTICE UNDER SECTION 3.—NOTICE OF SALE TO SATISFY A LIEN.

NORTH CAROLINA, }
Chatham County. }

Whereas, the undersigned as a mechanic and artizan has ["*made, altered, or repaired*"] the following personal property, to-wit: [*here enumerate the property,*] at the request of *John Den*, the legal owner or possessor of the same; and, as the costs and charges therefor have remained unpaid for the space of ——— days; the undersigned will sell the same on the — day of ———, 187—, at — o'clock, at ———, to the highest bidder for cash, to discharge said debt and lien, due and owing as aforesaid.

RICHARD FEN.

FORMS UNDER SECTIONS 4 AND 5.—ENTRY TO BE MADE BY MAGISTRATE OF FILING THE CLAIM.

NORTH CAROLINA, *Chatham County.* } *In a Justice's Court.*

Be it remembered that on the — day of ———, 187—, personally appeared before me, *John Doe*, a Justice of the Peace in and for said County, *John Den*, who filed before me the account and claim hereunto annexed, for the sum of —— dollars, as a lien upon the property of *Richard Fen*, under the Act of 1869-'70.

This the — day of ——, 187—. JOHN DOE, *J. P.*

NOTE 1ST.—Under Sec. 4, if the debt for work and labor done, is for fifty dollars or less, the property must be retained by the mechanic or artisan who "*made*, *repaired*, or *altered*" it, for thirty days, before advertising it for sale. If the debt be over fifty dollars, the mechanic or artisan must retain the property for ninety days before advertising it for sale. The notice, *under Sec.* 4, must be inserted for two weeks in some newspaper published in the County where the work was done; but, if no newspaper be published in the County, then the *notice must be posted "in three of the most public places in the county, town or city in which the work may have been done.* The two weeks' notice must be *two weeks exclusive of the day of sale.*

NOTE 2D.—"The proceeds of the said sale shall be applied first to the discharge of the said lien and the expenses and costs of keeping and selling such property, and the remainder, if any, shall be paid over to the owner thereof.' Last clause of Sec. 3.

REMARK.—*It seems* that Sec. 3, does not create any *new*

lien; but, is affirmatory of the lien which the mechanic or artizan had at common law. And *it seems* the object of Sec. 3, is to give a safe and speedy remedy for enforcing the lien. *It seems*, therefore, that liens acquired in the cases mentioned under Sec. 3, need not be filed before a Justice or Superior Court Clerk, as the mechanic is already in possession of the property. If the mechanic or artizan parts with the possession of the property, his right to the remedy, under Sec. 3, *it seems*, would be gone. The mechanic or artizan, under Sec. 3, may file his claim if he chooses so to do.

NOTE 3D.—*It seems* that Sections 4 and 5 define the remedies to enforce the liens mentioned in Sections 1 and 2, and may be filed *at any time* after the materials have been furnished, the labor performed, &c., and the lien may attach from time of filing. In suits to enforce the lien, before a justice, the *summons* should state in addition, the following words, "and for which claim of lien under the Act was filed before A. B., Esq." It is to be tried by the justice as any other cause.

REMARK.—No forms are inserted applicable to the Superior Court, in such cases, counsel learned in the law should be invariably consulted.

FORM OF JUSTICE'S JUDGMENT IN CASES UNDER THE LIEN ACT.

NORTH CAROLINA, *Chatham County.* } *In a Justice's Court,*

JOHN DEN, *Plaintiff,* *Against* RICHARD FEN, *Defendant.* } *Action to enforce lien under Act* 1869–'70.

In the above entitled cause, it is ordered, adjudged and decreed, that the plaintiff do recover of the defendant the sum of —— dollars and costs to the amount of —— dollars, with interest on, &c.

And it is further ordered, adjudged, and decreed, that the said lien of the plaintiff is valid, and binding upon the following property of the defendant, to-wit: [*here set out the property upon which the lien attaches*, and that the same be condemned to be sold to answer the debt and judgment in this cause.

A. B., *J. P.*

WILLS.

In the name of God, Amen. I, *John Den*, of sound and disposing mind and memory, being desirous of settling my worldly affairs, whilst having the capacity so to do, do declare this to be my last will and testament:

ITEM 1. It is my will that, &c.

ITEM 2. I give, devise, and bequeath unto A. B., &c. [*By items set out the property and to whom given, &c.*]

ITEM 3. I appoint and make C. D., my executor to this, my last will and testament.

In witness of all which things I have hereunto set my hand and seal this the — day of ——, A. D., 187—.

Signed, sealed and published in the presence of RICHARD ROE, JOHN DOE.

REMARK.—As the lien law is of great importance to mechanics and laborers, it ish ere below appended as found in "Laws of North Carolina, Chap. CCVI. 1869–'70.

AN ACT FOR THE PROTECTION OF MECHANICS AND OTHER LABORERS, MATERIALS, ETC.

SECTION 1. *The General Assembly of North Carolina do enact*, That every building built, rebuilt, repaired or improved, together with the necessary lots on which said building may be situated, and every lot, farm or vessel or any kind of property not herein enumerated shall be subject to a lien for the same or material furnished.

SEC. 2. The lien for work on crops or farms or materials given by this act shall be preferred to every other lien or incumbrance which attached upon the property subsequent to the time at which the work was commenced or the materials were furnished.

SEC. 3. Any mechanic or artizan who shall make, alter or repair any article of personal property at the request of the owner or legal possessor of such property, shall have a lien on such property so made, altered or repaired for his just and reasonable charge for his work done and material furnished, and may hold and retain possession of the same until such just and reasonable charges shall be paid; and, if not paid for within the space of thirty days, provided it does not exceed fifty dollars, if over fifty dollars ninety days, after the work shall have been done, such mechanic or artizan may proceed to sell the property so made, altered or repaired at public auction, by giving two weeks public notice of such sale by advertising in some newspaper in

the county in which the work may have been done, or if there be no such newspaper, then by posting up notice of such sale in three of the most public places in the county, town or city in which the work may have been done, and the proceeds of the said sale shall be applied first to the discharge of the said lien and the expenses and costs of keeping and selling such property, and the remainder, if any, shall be paid over to the owner thereof.

SEC. 4. All claims under two hundred dollars may be filed in the office of the nearest magistrate if over two hundred dollars, in the office of the superior court clerk in any county where the labor has been performed or the material furnished; but all claims filed shall be in detail, specifying all materials furnished or labor performed, and at what date it was performed or material furnished in case of contract or otherwise. If the parties interested make a special contract for such labor performed, or if such material and labor are specified in writing, in such cases it shall be decided agreeable to the terms of the contract, provided the terms of such contract do not effect the lien for such labor performed or materials furnished.

SEC. 5. In case of any disagreement between the parties interested in any such contract it may be brought before the nearest magistrate by the plaintiff or defendant for arbitration or otherwise, as the magistrate may decide, provided the amount claimed does not exceed two hundred dollars; if over that amount, all claims must be filled with the clerk of the superior court and entered on the calendar so as to be brought before the court at the first term after the filing of any claims. The judges of the superior court may ap-

point referees to ascertain the proper value of any labor performed on any building or farm, or any material furnished or specified in the application at the time of plaintiff or defendant filing his petition.

SEC. 6. That nothing contained in this act shall be construed to affect the rights of any person to whom any debt may be due for any work done which priority of claims filed with the proper officer.

SEC. 7. Costs are allowed to either party upon the rules established by law in actions arising or contracts made under the code of civil procedure.

SEC. 8. The defendant in any suit to enforce the lien shall be entitled to any set off or claim arising between the contractors during the performance of the contract.

SEC. 9. That all laws or parts of laws coming in conflict with the provisions of this act are hereby repealed.

SEC. 10. That this act shall be in force from and after its ratification.

Ratified the 28th day of March, A. D. 1870.

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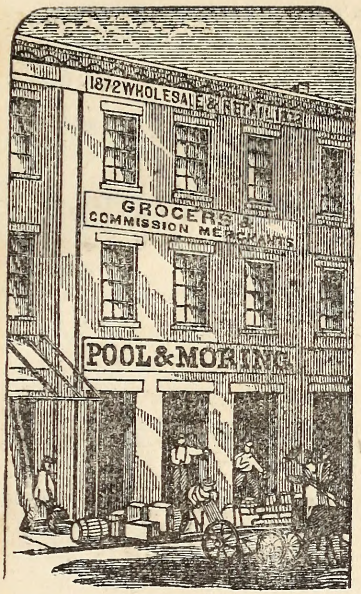
The author is a North Carolinian, and if his book possesses real merit, North Carolinians ought to encourage his talent and give him their patronage."



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